9-2016

The Discursive Functioning of Knowledge Claims in Research Studies on Children’s Conceptual Knowledge of Number

Patrick D. Byers

The Graduate Center, City University of New York

How does access to this work benefit you? Let us know!

Follow this and additional works at: https://academicworks.cuny.edu/gc_etds

Part of the Cognitive Psychology Commons, Developmental Psychology Commons, Epistemology Commons, Philosophy of Mind Commons, and the Theory and Philosophy Commons

Recommended Citation

Byers, Patrick D., "The Discursive Functioning of Knowledge Claims in Research Studies on Children's Conceptual Knowledge of Number" (2016). CUNY Academic Works.

https://academicworks.cuny.edu/gc_etds/1400

This Dissertation is brought to you by CUNY Academic Works. It has been accepted for inclusion in All Dissertations, Theses, and Capstone Projects by an authorized administrator of CUNY Academic Works. For more information, please contact deposit@gc.cuny.edu.
THE DISCURSIVE FUNCTIONING OF KNOWLEDGE CLAIMS IN RESEARCH STUDIES ON CHILDREN’S CONCEPTUAL KNOWLEDGE OF NUMBER

by

PATRICK BYERS

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2016
The discursive functioning of knowledge claims in research studies
The discursive functioning of knowledge claims in research studies

The Discursive Functioning of Knowledge Claims in Research Studies on Children’s Conceptual Knowledge of Number

by

Patrick Byers

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

____________________________  ______________________________
Date  Advisor Name

____________________________  ______________________________
Date  Chair of Examining Committee

____________________________  ______________________________
Date  EO Name

Executive Officer

Supervisory Committee:

Colette Daiute
Patricia Brooks
Robert Campbell
Bruce Homer

THE CITY UNIVERSITY OF NEW YORK
The discursive functioning of knowledge claims in research studies

ABSTRACT

The Discursive Functioning of Knowledge Claims in Research Studies on Children’s Conceptual Knowledge of Number

by

Patrick Byers

Advisor: Joseph Glick

Researchers interested in the development of conceptual knowledge of number have studied children’s behavior in various tasks or other contexts in order to draw conclusions about what they know. The guiding assumption of this work is that the presence or absence of a given form of knowledge is typically reflected in the ability/ inability to perform certain types of behavior. Researchers complicate this assumption when they claim that (1) the ability to perform a given behavior may also reflect simple imitation or rote learning in the absence of understanding, and/or (2) that the inability to perform a certain behavior may reflect extraneous performance demands, rather than the absence of underlying conceptual knowledge. Most problematically, it is not clear how to distinguish these alternative explanations of the relationship between behavior and conceptual knowledge. The difficulty of making this distinction has led to ongoing issues in cognitive development research that have persisted despite researchers’ attempts to resolve them through the ongoing study of children’s behavior.

The current research explores how and whether the issues researchers face in interpreting behavior vis a vis knowledge might be clarified by studying the discursive practices in terms of which these interpretive processes themselves occur. The current study analyzes the discursive functioning of knowledge claims—assertions about what children know, e.g., s/he
The discursive functioning of knowledge claims in research studies

understands the cardinal principle—in the texts of eleven published research articles on developing conceptual knowledge of number. Therefore, while the goal of this study is to contribute to the general research area of cognitive development, the methodology used in the current study was a discourse analysis. The focus of the analysis is on the strategies and conditions under which knowledge claims are asserted and justified (i.e., claimed to be valid). The results suggest that knowledge claims are descriptions of behavioral dispositions, that are produced in response to the observation of behavior in situations presumed to make that behavior interpretable. The behavioral tasks used by researchers to assess children’s conceptual knowledge function as ways of eliciting concrete instances of the behavior that is described in more general terms by the knowledge claim. The fact that knowledge claims are descriptions of behavior is shown to be obscured by deeply rooted discursive practices that reify knowledge in ways that allow it to be categorically distinguished from behavior. Ironically, the use of this knowledge-behavior distinction in the research reports, and subsequent issues it causes, are parsimoniously explained by the theory that knowledge claims are descriptions of behavioral dispositions, articulated in response to situations that are presumed to allow general interpretations of observed behavior.

The findings of the current research suggest that the entrenched distinction between competence and performance is problematic, and that its use comes at the expense of a clear view of what it means to say that someone knows something. However, these problems may represent growing pains in the development of a new and better conception of knowledge in cognitive psychology.
The discursive functioning of knowledge claims in research studies

ACKNOWLEDGEMENTS

This project would not have come to completion without the social support of several faculty at the Graduate Center, including Patricia Brooks, Colette Daiute, and above all, Joseph Glick. Joe's patient intellectual guidance, and compassionate support were a particularly important source of encouragement over the past six years. For the intellectual roots of this project, I'm indebted to Marianne Wiser and Jaan Valsiner for their brilliant support during my time at Clark University, and afterwards. Even more importantly, my parents, Eric and Kristen Byers, helped me to make this project possible in the fullest sense, with help and support of all kinds. Finally, I'm most deeply indebted to my beloved wife, Sarah Kalogeros, who has believed in me, supported me in every sense, and whose relationship provided the context that made it possible for me to do this kind of work.
The discursive functioning of knowledge claims in research studies

Table of Contents

CHAPTER 1. INTRODUCTION……………1
  1. Specific Focus
  2. Investigations of Children’s Knowledge of Number
  3. Choice of Studies
  4. Terminology
  5. Organization

CHAPTER 2. LITERATURE REVIEW……………7
  1. Chapter Overview
  2. Claims of Early Numerical Competency
  3. Overall Conclusions from Researchers’ Reports of Findings on Children’s Number Use
  4. What it Means to Understand Number
  5. Towards an Alternative Approach to Knowledge
     a. Discursive Psychology
     b. Rationale for the Study of Knowledge Claims
     c. Interpretive approach

CHAPTER 3. GOALS AND METHOD OF THE CURRENT RESEARCH………28
  1. Research Question
  2. Site of Analysis
  3. Initial Analytical Categories
     a. Knowledge Claims
     b. Justifications
  4. Locating Knowledge Claims and Justifications in the Text
  5. Goal of Analysis: A Model of the Semiotic and Discursive Functioning of Knowledge Claims
  6. Methodology
     a. Process of Analysis
     b. Selection of Texts for Analysis

CHAPTER 4: STUDY 1: PRELIMINARY ANALYSIS OF SARNECKA AND CAREY ARTICLE IN TERMS OF INITIAL CATEGORIES………………38
  1. Identifying Knowledge Claims and Justifications in the Sarnecka and Carey Text
  2. Initial Development of Analytic Categories
     a. Clarification of Knowledge Claim and Justification Categories
     b. New Analytic Categories
        i. Higher order Knowledge Claims
        ii. Explanations
          1. Explanations and Concurrent Validity
  3. Initial Consideration of the Relationship Between Knowledge Claims, Justifications and Explanations
     a. The Relationship Between Knowledge Claims and Justifications
        i. Self-evident connections between knowledge claims and justifications
        ii. Knowledge Claim-Justification Pairs Mediated by Explanations
     b. An Alternate Role for Explanations: Type 2 Explanations
The discursive functioning of knowledge claims in research studies

4. Summary of Results of Study 1
   a. Basic Model

CHAPTER 5: STUDY 2: ANALYSIS OF ADDITIONAL TEXTS ..........62
   1. Issues and Directions for Further Analysis
      a. Testing and Refining the Model of Knowledge Claim Functioning
   2. Results of Study 2
   3. Revisions to Explanation Categories and New Types of Explanations
      a. Type 1 Explanations
         i. Differentiation of explanation Type 1 into Types 1a and 1b
         ii. Reassessment of concurrent validity in Type 1 explanations
         iii. Redescription as a feature of Type 1a explanations
      b. Type 2 Explanations
         i. Differentiation of explanation Type 2 into Types 2a and 2b.
         ii. Type 2a Explanations
         iii. Type 2b explanations
         iv. Type 2b explanations and addressivity
      c. Implication of New Explanation Categories for the Model
   4. Revision of Knowledge Claim-Justification Distinction
      a. Lack of a Clear Boundary Between Knowledge Claims and Justifications
         i. Overlap in the range of statements used as knowledge claims and justifications.
      b. Implications of the Interchangeability and Similarity of Knowledge Claims and Justifications
         i. Explaining the Normative Pairing Between Claims and Justifications.
   5. Assessing the Validity of the Model Across Historical Periods

CHAPTER 6: REVISED MODEL OF KNOWLEDGE CLAIM FUNCTIONING ..........95
   1. Components and their Interrelationships in the Model of Knowledge Claim Functioning

CHAPTER 7: VALIDITY AND RELIABILITY OF THE MODEL VIS A VIS THE SAMPLE .....98
   1. Intra-Rater Reliability
      a. Measuring Intra-Rater Reliability
      b. Characterizing Similarities and Differences Across Representations
      c. Repeated Labels
         i. Asymmetrical Equivalence and Merged Claims.
         ii. Enumerating Equivalent Statements
      d. Repeated Edges
      e. Repeated and Non-repeated Explanation Citations
   2. Findings Regarding the Equivalence Between Statements, Links and Citations in the Representations
   3. Similarity of Representations Relative to Chance
      a. Reliability in the use of explanation categories
   4. Reliability of Model Across Historical Periods
      a. Integration of Knowledge Claims within Hierarchical Networks

CHAPTER 8: SUMMARY OF RESULTS AND EMERGING ISSUES ..........118
   1. Summary
The discursive functioning of knowledge claims in research studies

2. Use of the Model to Characterize the Use of Knowledge Claims in Different Cultural-Historical Contexts
3. Separation of Competence and Performance and the Objectification of Knowledge
   a. Making Sense of “Competence Before/After Performance” Claims
   b. Objectification
4. Inductive Inferences About Knowledge
5. Described and Actual ispositions

CHAPTER 9: DISCUSSION..................128
1. Generalizability of the findings to other research areas in cognitive development
2. Contribution to the competence-performance issue
   b. Relevance of the Current Results
   c. Differing Conceptions of Competence
3. Implications of the Model for Cognitive Psychology

APPENDIX 1.................138
APPENDIX 2.................146
APPENDIX 3.................165
APPENDIX 4.................167
APPENDIX 5.................173
APPENDIX 6.................175
APPENDIX 7.................182
APPENDIX 8-20 (Separate Documents)
BIBLIOGRAPHY............188
The discursive functioning of knowledge claims in research studies

LIST OF TABLES & FIGURES

Table 1. Texts included for analysis in Study 2 (p. 35)

Table 2. Deconstruction of a statement to reveal implicit knowledge claims/justifications (p. 42)

Table 3. Quote with knowledge claim, justification and explanation components extracted (p. 47)

Table 4. Explanations (and the arguments on which these are founded) concerning the validity of the How-Many or Give-N tasks as measures of the cardinal principle (p. 50)

Table 5. Examples of re-described knowledge claims from the analyzed texts (chart continues onto next page) (p. 70)

Table 6. Examples of Type 2b explanations (p. 76)

Table 7. Examples of knowledge claims/justifications (p. 81)

Table 8. Descriptive statistics on repeated/total labels, explanations, explanation citations, edges, and merged labels (p. 107)

Table 9. Descriptive statistics and probabilities for actual/possible/repeated edges (p. 110)

Table 10. Number of possible and actual shared explanation category assignments for each article (p. 112)

Table 11a. Knowledge Claims and Justifications in Older and Newer Texts (p. 116)

Table 11b. Average number of networks by network depth (p. 117)

Figure 1. The general hierarchical structure of knowledge claims as descriptions of capacities (p. 88)

Figure 2. A simplified example of the type of representations created in the intra-rater reliability assessment (p. 102)
The discursive functioning of knowledge claims in research studies

CHAPTER 1: INTRODUCTION

Historically, epistemology has been advanced by pursuing questions about knowledge from alternative directions, and in alternative contexts. For example, important insights about the nature of knowledge have resulted from Piaget’s investigation of the topic of knowledge in terms of its ontogenetic development, which revealed insights that were largely unrecognized by philosophers—specifically that knowledge must be embodied and emerge/self-organize through the organism’s interaction with the environment—but which are gradually being recognized for their importance (e.g., Bickhard and Terveen, 1995).

Inspired partially by the success of Piaget’s alternative approach to the study of knowledge, the current research hopes to take yet another approach in the hope that it will yield new insights about epistemological issues. The current study is concerned with the discursive dimension of knowledge, specifically, how claims about what a person knows are made, how they may be justified, and what determines whether they are valid or invalid. These discursive dimensions of the topic of knowledge have been largely overlooked in existing research on conceptual development. In the current study, claims about what a person knows are labeled knowledge claims, which may be defined as ways of characterizing what someone knows such as s/he knows how counting works, or s/he understands that objects continue to exist when they are out of view (knowledge claims will be defined in greater detail later on).

The current research aims to study the ways that claims about what people know are discursively constructed on the assumption that the discursive dimensions of knowledge have been overlooked in existing research and theory on knowledge, and that by focusing on these dimensions, we may reevaluate existing theoretical ideas about knowledge and inform their ongoing development.

1.1 Specific Focus

Discursive refers to the phenomenon and processes of language use considered in their own terms—not as a representation or reflection of something else. A discourse (singular) refers to a conversation in a general sense that covers any set of utterances...
The discursive functioning of knowledge claims in research studies

There is not a single discourse on knowledge. Presumably, knowledge is talked about in different ways in different contexts, and these may be more or less different discourses. The ultimate aim of the current research is to contribute to a general understanding of knowledge by analyzing how it is constructed discursively in specific cases. Given the undetermined heterogeneity of the discourses on knowledge, the current study focuses on a narrowly delimited area of knowledge discourse: claims about what children know about numbers made within the texts of a particular selection of cognitive development research studies. While it is hoped that the conclusions from the study of this limited area will be applicable more generally, this is an empirical matter; generalizability cannot be guaranteed and must be determined by future investigations.

1.2 Investigations of Children’s Knowledge of Number

Research on the development of conceptual knowledge of number in preschool children has been prominent to the field of cognitive development. While studies in this area have illustrated relevant and important findings regarding children’s use of numbers in naturalistic and contrived settings, a coherent picture of how children’s conceptual knowledge of number develops, as well as a clear consensus among researchers about what a child knows at any given point in time has yet to be achieved. One central issue is that, although young children have been shown to use numbers with some proficiency, researchers disagree about what a given behavioral proficiency implies about what the child knows about numbers, specifically whether a behavioral performance reflects either procedural knowledge or conceptual knowledge of the principles embodied in the performance.

Attempts to determine whether a given behavioral performance reflects either procedural or conceptual knowledge have ultimately been inconclusive,² as the next section illustrates. This

---

² The “inconclusiveness” in question refers to the researchers’ own conclusions. Given the wealth of theoretical frameworks in psychology, there are multiple ways to make sense of many of the findings reviewed here; e.g., to consider experimental situations as social interactions in which the child’s behavior is an emergent result of their construal of the demands of the social
The discursive functioning of knowledge claims in research studies

inconclusiveness raises questions about what it means for a child to understand numbers or counting. The current study argues that to adequately resolve these issues, the relevant empirical phenomena are not additional findings regarding how children use numbers. Rather they are discursive processes through which claims about what a child knows are asserted, contested, and negotiated: the ways and conditions under which knowledge claims such as s/he knows how counting works, or s/he understands that the last word reached in counting a set of items represents the numerosity of the set are asserted, contested and negotiated, as well as the significance and implications of these claims. In short, the premise of the current research is that analyzing the ways that knowledge claims are used in discourse may provide a way to resolve the interpretive difficulties involved in cognitive development research.

1.3 Choice of Studies

The research that is focused on in the literature review beginning in the following sections, as well as the research texts that are the focus of current discourse analysis is not representative of all investigations of the cognitive development of number use in children. For the sake of a clear and manageable analysis, the research that is focused on is delimited by several criteria intended to limit the focus to a specific discourse, or set of related discourses. The types of studies that are analyzed conduct observational or experimental investigations of children’s counting with the intent of verifying the accuracy of claims about what research participants know (including propositional knowledge as well as knowledge of how to do something). For example, these studies might investigate whether children know that the last word reached in counting signifies the entire set or whether children know how to produce a set of a requested number of items. Although there are other ways to characterize and study a child’s knowledge of number (e.g., in terms of the neurological structure of the brain), the research in question is highly visible and central to the field of cognitive development (in terms situation. However, for the purposes of the current project, the emphasis in the literature review will be on researchers’ own interpretations. This is in keeping with the ultimate goal of making sense of the discourse in the research studies themselves.
The discursive functioning of knowledge claims in research studies
of citation counts, NIH funding, and in informing educational standards such as the Common Core).

Additionally, with some exceptions, the analyzed studies will be primarily focused on numerical thinking in preschool-aged (3 to 5-year-old) children. There are several reasons for choosing this age range. First, a very substantial amount (if not most) of the research on children’s conceptual knowledge of numbers has focused on it. Second, a consistent age range allows for consistent examples to be used. Finally, the preschool age range is a unique moment in cognitive development in which a child’s capacity for action is simultaneously sophisticated enough for observation of more complex forms of action (as opposed to younger children who must often be observed through looking time or habituation studies), but at the same time, the child’s grasp of conventional forms of activity is qualitatively distinct from that seen in older children and adults.

The analyzed research comes (unless otherwise noted) from American or European contexts, and generally involves empirical studies of middle/upper class children. These populations are heavily overrepresented in psychological research, and in particular, within the type of research that is the focus of the present paper (as described in the beginning of this subsection). This limited sampling limits the external validity of the research findings insofar as there is substantial evidence of variability across communities in the ways that numbers are used, and the ways that this use develops. Although it is important for researchers to consider a wider variety of developmental pathways for developing number use, this issue is tangential to the concerns of this paper, which pertains to the discourse within a specific body of existing research on children’s number use. Whether the issues raised here will also be found in research with more varied populations is a matter for further investigation.

1.4 Terminology

The research studies that are the focus of this paper are concerned with a small variety of phenomena surrounding children’s knowledge of numbers. Some of the studies are more
The discursive functioning of knowledge claims in research studies explicitly focused on children’s use of counting, while others are more focused on numbers used in non-counting contexts. Despite these differences, the analyzed studies are connected in that they are focused on children’s conceptual understanding of the cardinal properties of number, which may be approached in terms of counting or by other means. For the sake of simplicity, children’s general use/knowledge of either numbers or counting will be described as use/knowledge of number, with further specification used as necessary.

Similarly, some of the analyzed studies characterize children’s conceptual knowledge with the word understanding, whereas others use the word knowledge. Unless a difference in the intended use of these terms is apparent and relevant, they will be used interchangeably, with the choice of one or the other made only to enhance grammatical flow.

1.5 Organization

The goal of this analysis is to (first) introduce problems in the use of knowledge claims in cognitive development research, and (secondly, and as a solution), construct a model of how knowledge claims function discursively. To do this, an initial analysis of knowledge claims in a selected group of texts is used to refine a rough set of analytic categories. These categories raise additional questions, which are addressed through further analysis, the results of which are used to further refine the analytic categories. Eventually, the iteratively refined analytic categories are integrated into a model of the discursive functioning of knowledge claims, which in turn generates still further questions, analysis and ongoing refinement of the model. Therefore, to explain the ultimate conclusions of this research, it is necessary to report preliminary results and interpretation from various stages of the analysis. The division of the results and interpretation into two separate studies (Study 1 and Study 2) facilitates the presentation of preliminary results and interpretation (Study 1) that serve as the foundation for subsequent analyses (Study 2). This approach is further reflected in the organization of the current paper, which is as follows.
The discursive functioning of knowledge claims in research studies

After the current chapter (Chapter 1; the introduction), Chapter 2 is a literature review of research on the development of number and counting knowledge in preschool children. The purpose of this is to illustrate basic findings, technical terms, and interpretive issues that are relevant to the current study, and necessary for explaining its rationale. Chapter 2 also introduces discursive psychology as an alternative approach that provides a useful framework for addressing the aforementioned issues.

The remaining chapters (3-8) deal with the current study. Chapter 3 explains the overall rationale, goals, and methodology of the study. The initial analytic categories used in the discourse analysis are also introduced in this chapter. Chapter 4 describes the results and interpretation of the initial discourse analysis of one of the selected texts. Based on these results, a larger analysis of more texts is conducted, and its methodology, results, and their interpretation are discussed in Chapter 5. In Chapter 6, the final model of knowledge claims is described, based on the results of the text analyses. Chapter 7 describes a quantitative assessment of intra-rater reliability, intended to demonstrate that the model was consistently applied to the analyzed texts. Chapter 8 discusses issues raised by the results and their interpretation, while Chapter 9 is a discussion of the broader implications of the findings. In addition to these chapters, Appendices 1-20 contain various supplementary information to extend certain peripheral topics mentioned throughout the paper.
The discursive functioning of knowledge claims in research studies

CHAPTER 2: LITERATURE REVIEW

2.1 Chapter Overview

This chapter describes research on developing numerical knowledge in preschool children, identifies interpretive problems in that research, and introduces an alternative framework that may be useful for addressing the problems that have arisen.

2.2 Claims of Early Numerical Competency

Rochel Gelman’s work (Gelman, 1972; Gelman & Gallistel, 1978) claims that young preschool children implicitly understand certain principles about number and counting. In one study, Gelman (1972) observed 3- to 6-year-olds’ reactions to a situation in which a small set of objects was transformed, either in terms of number or displacement (i.e., after participants had been shown the set for the first time, items in it were surreptitiously either added/removed, or simply moved around, then participants were shown the changed set, and their reactions were recorded). Contrary to Piaget’s (1965) claims that young children do not perceive number as invariant, Gelman showed that children would show surprise when the number of items surreptitiously changed.\(^3\) Similar findings of awareness of numerical invariance in very young children have been reported by a variety of other researchers (e.g., Mix, Levine and Huttenlocher, 2002; Spelke and Kinzler, 2007; Wynn, 1992, although these findings have been challenged by Feigenson, Carey and Spelke, 2002).

Gelman and Gallistel (1978) argued that very young children’s numerical competence is a reflection of their understanding of various principles that govern counting. These include the ‘one-to-one principle’ (one and only one number word should be applied to each counted item), the stable order principle (the number words in the count-sequence must be stated in a stable order), the abstraction principle (the understanding that heterogeneous sets of entities can be counted), the order irrelevance principle (the realization that the order that objects in a set are

\(^3\) It should be noted that this latter research focused on very small numbers (<5), which Piaget and collaborators intentionally avoided.
counted is irrelevant), and the cardinal principle (the understanding that the last number reached when counting a set of items refers to the entire set). The development of children’s understanding of cardinality—which, more generally, refers to the way in which numbers are used to refer to numbers of things, as opposed to being used to order (1st, 2nd, 3rd) or name things (the 49 bus)—has been the focus of extensive research, particularly in the context of counting.

Gelman and Gallistel’s claims about early conceptual knowledge of the counting principles are derived from observing young children’s behavior in situations that are carefully designed to remove any extraneous difficulties that may interfere with demonstrating their conceptual knowledge. While the resulting observations are typically of relatively limited “slices” of behavior, the situations in which these occur are carefully designed to support arguments that conceptual knowledge of number is the only explanation for the observed behavior.

Gelman and Gallistel’s work is typical of post-Piagetian work (e.g., Saxe, 1979; Schaeffer, Eggleston and Scott, 1974) in that it embraces counting as a relevant site of developing numerical thinking. However, many subsequent researchers' interpretations of children’s behavior vis a vis their knowledge are quite different. While Gelman and colleagues tended to argue that children had conceptual knowledge of number at a young age but had difficulty putting it into practice, subsequent researchers have argued that children develop procedural competence in using numbers without having a conceptual understanding of what they’re doing (Briars & Siegler, 1984; Fuson, 1988; Wynn, 1990).

Researchers have found that many children will respond conventionally when asked common questions (e.g., giving their correct age when asked how old are you or counting a set of objects when asked how many are there). However, when asked variations on these questions that require them to use numbers in novel ways, children often demonstrate very unconventional or seemingly illogical uses of number. Several comprehensive surveys of
The discursive functioning of knowledge claims in research studies

counting proficiency in American children (Fuson, 1988, 1992; Sophian, 1987; 1992; Wynn, 1990) provide an abundance of examples to illustrate this.

Wynn (1990) describes children who, after counting a set of items in response to the question 'how many are there', would respond to a repeat of the question by counting the set of objects again, suggesting (to Wynn) they viewed the question as nothing more than an invitation to count (this behavior persists even when the task is changed to minimize the pragmatic strangeness of asking a child the same question twice in close succession). Similarly, Sophian (1992), who asked children to count in a variety of different ways (e.g., counting to compare the numerosity of two sets, counting up to a certain number, counting the items in a set), reports that although very young children often counted, they frequently used counting in unconventional or illogical ways, even on seemingly similar questions.

Interestingly, even in cases in which children begin to use number in more sophisticated ways that appear to be more connected to an underlying body of conceptual knowledge, it often turns out that they have merely increased the sophistication of their participation in the rituals of number use without deeply understanding the mathematical and logical significance of what they are doing.4

---

4 One critique of this interpretation is that it requires that children’s behavior be interpreted solely in terms of its conformity to mathematical/logical rules. There are valid arguments against such an interpretation. A particularly useful way to view the development of children’s early number use is suggested by Munn (1998) who argues that children’s developing ability to use numbers reflects their increasingly sophisticated engagement (and eagerness to engage) in the social interactions in which number use occurs, rather than as the unfolding of a logical understanding of number. Other researchers have described similar participatory approaches to children’s developing number use (Sfard, 1998) and cognitive development more generally (Rogoff, 1991).

The participatory approach to understanding children’s number use underscores the fact that children’s use of numbers is a function or more than abstract conceptual knowledge of number and performance/memory/processing demands. To the extent that numerical activities are social scripts (see Saxe, 2012 for an in-depth exploration of this possibility), children’s aptitude with them reflects a desire to take part in a community at least as much as the outcome of developing conceptual understanding of the logical principles of number.

Despite the validity of this objection, the goal of the current study is to analyze these findings as representative of a given discourse. Therefore, objections made about certain discursive practices, while valid, are not relevant for the current purposes.
The discursive functioning of knowledge claims in research studies

In one such instance, Fuson (1992) describes the responses of older preschoolers that were asked to count a set of (five) toy soldiers. Upon completing their count, she asked them to hand her the five soldiers, to which some children responded by handing the last counted (fifth) soldier only. Other children made similar sorts of errors in other situations, e.g., by referring to the last counted item as the “fives.” Wynn (1990) identifies similar children whom she labels “last word responders.” These are children who appear have learned that the question how many is not just an invitation to count. They treat the last word as important, responding to a repeat of the question (“how many”) with the final counted number words they reached in their count, rather than simply counting again. Nevertheless, Wynn found evidence that this did not reflect conceptual understanding of the cardinal principles of counting. The children reported by Wynn were unable to accurately produce a set of a requested number of items, something that is assessed with the so-called give-a-number task, a widely used measure of preschooler’s counting competence (Condry & Spelke, 2008; Gunderson & Levine, 2011; Le Corre & Carey, 2007; Levine et. al., 2010; Sarnecka & Carey, 2008; Sarnecka & Gelman, 2004; Sophian, 1992; Wynn, 1990).

Two things are striking about performance on the give-a-number task. First, children who give out an incorrect number of items tend to do so in a cavalier manner, grabbing a seemingly random bunch of items in response to a request for a specific number. The second striking finding is that, over the course of the preschool years, children appear to achieve competence on the task one number at a time (Le Corre & Carey, 2007). For instance, a child may first learn to give out one, then two, then three items correctly, while grabbing an arbitrarily large number of items for all other requested numbers. Eventually, around the end of preschool for many middle class North American children, the correct response appears to be generalized to all numbers they can reach with counting. Once children generalize the ability to produce a requested number of items to all numbers, researchers consider them to understand how
The discursive functioning of knowledge claims in research studies

counting works, or (as alternately described by the same researchers) to understand the cardinal principle (Sarnecka & Carey, 2008).

Recent work has used performance on the give-a-number task as a reference point for assessing other aspects of children’s numerical knowledge, relating performance on these tasks to their level of performance on the give-a-number task. For example, Sarnecka and Carey (2008) conducted a study that compared 2- to 4-year-olds who understand how counting works (cardinal principle knowers) to those who do not (subset knowers), in order to better characterize the knowledge itself. New results are that (1) Many children answer the question ‘how many’ with the last word used in counting, despite not knowing how counting works; (2) Only children who have mastered the cardinal principle, or are just short of doing so, understand that adding objects to a set means moving forward in the numeral list whereas subtracting objects means going backward; and finally (3) Only cardinal-principle-knowers understand that adding exactly 1 object to a set means moving forward exactly 1 word in the list, whereas subset knowers do not understand the unit of change. (Sarnecka & Carey, 2008, p. 662).

Other work that builds on the give-a-number task as a reference point for children’s competence with counting has attempted to determine what children understand about “unmapped” number words, i.e., number words that they are unable to produce correctly on the give-a-number task. In several studies, researchers have investigated whether children understand that unmapped number words nevertheless indicate specific, unique numerosities (Condry & Spelke, 2008; Sarnecka & Gelman, 2004). In these studies, preschool-aged participants were presented with a set of items, which were given a cardinal number label by the researchers (e.g., “Here are 5 blocks”). Then, the set was altered in ways that either did (removing an item) or did not (shaking the set of items) affect its numerosity. Afterwards, participants were asked about the number of items currently in the set(s). The presumption was that if children realize that the set had
The discursive functioning of knowledge claims in research studies contained a specific, unique numerosity, and understand how this is related to the number of items in the set, their answer to the question should depend on whether the set had been numerically altered, or merely shaken. Surprisingly, both Sarnecka and Gelman (2004) and Condy and Spelke (2008) found that slightly different versions of the above question/task elicit different responses from children. In the version of the task with a single set of items (described above), preschool participants claimed that the numerosity changed only when an item had been added or removed (not when the set had been shaken). However, in a similar version of the task that involved two sets, children showed no inclination to distinguish between the effects of numerical and non-numerical changes to the sets.

Understood as measures of children’s numerical knowledge, the difference between these two tasks is unclear. The researchers ruled out simple memory effects, and other likely confounds, and found the same results. If the tasks assessed children’s underlying numerical knowledge, it was unclear why they would elicit different performances, since both require essentially the same competency—the understanding that number words refer to specific numerosities.

Recent findings by Brooks, Audet and Barner (2012) shed light on this paradox. They replicated the original results, but also included non-numerical versions of the original tasks in which the numbered sets were replaced with novel conglomerations of objects made of blocks and loops of rope, and given novel names. They found the same differences in performance on non-numerical versions of the tasks. These results strongly suggest that differences in children’s performance across the two types of tasks was driven by pragmatic inferences relating to the question and context. The fact that children answered in similar ways on numerical and non-numerical versions of the same task raises the possibility that their answers to other numerical tasks are not a function of conceptual thinking that is uniquely tied to numbers.

**2.3 Overall Conclusions from Researchers’ Reports of Findings on Children’s Number Use**
The discursive functioning of knowledge claims in research studies

The previously described research on children’s number use has produced a rich body of evidence that provides an in-depth glimpse at the emergence of various numerical skills in (generally middle class North American) preschool children. It is clear from several decades of research that the use and sophistication of children’s counting increases dramatically over the preschool years. Children begin simply reciting a few number words, and gradually learn to apply their counting in different contexts and in different ways. Their ability to show reasoning and reach conclusions regarding numbers becomes increasingly sophisticated as well.

To a significant extent, the extensive body of findings on children’s counting has been driven by the recognition that many of children’s observed uses of counting appear to be nothing more than the execution of rote behavior, rather than conceptually informed action. In fact, the rate at which researchers have reported new, more valid demonstrations of children’s counting knowledge appears to be matched by the rate at which assumed-to-be-valid indications of knowledge are shown to be merely the execution of rote behavior (Byers, 2016). The latest example of this comes from Davidson Eng and Barner (2012), whose findings undermined the validity of the give-a-number task as a measure of children’s understanding of the cardinal principle/how counting works. They report that children who had mastered the give-a-number task “often do not know (1) which of two numbers in their count list denotes a greater quantity, and (2) that the difference between successive numbers in their count list is 1.” (Davidson, Eng & Barner, 2012, p. 162). If, as previous researchers have claimed (Condry & Spelke, 2008; Le Corre & Carey, 2007; Sarnecka & Carey, 2008; Sarnecka & Gelman, 2004; Sophian, 1992; Wynn, 1990), the give-a-number task is a valid measure of children’s understanding of the cardinality principle, this gap in performance makes no sense.

2.4 What it Means to Understand Number

The failure to come up with valid criteria for determining whether and when children understand certain things about numbers raises fundamental questions about what it means to ‘understand’ number. Part of the problem is an inherent consequence of the researchers’
The discursive functioning of knowledge claims in research studies

approach to investigating children’s conceptual knowledge. An inherent problem in this research is that, on one hand, in attempting to study children’s conceptual knowledge, this knowledge has been measured in terms of specific forms of behavior (e.g., the ability to produce a set of X items). On the other hand, a consistent theme throughout these investigations has been the discovery of children’s conceptually impoverished (rote or mimicked) uses of number, and the resulting attempt to distinguish rote actions from conceptually grounded ones.

Trying to use behavioral criteria to distinguish rote from conceptually informed activity is problematic at best, and a dead end at worst. There is no sign or consistently valid criterion that distinguishes between behavior that is carried out by rote and behavior that is guided by conceptual knowledge. Researchers may claim that a given measure of some form of knowledge involves too many performance demands, and substitute it for another task. Yet, this new task will itself have new performance demands, and could in turn be claimed to underestimate the child’s knowledge. Finally, to the extent that a task involves minimal performance demands, it becomes increasingly possible to claim that it is being carried out by rote. This raises serious questions about what it means to ‘understand numbers’, and how this topic could be the focus of investigation.

The difficulty of pointing to what conceptual knowledge is can be illustrated, using as an example the description of what “it means to know numbers” from Sarnecka and Wright (2013).

Understanding what numbers are means knowing several things. It means knowing how counting relates to numbers (called the cardinal principle or cardinality); it means knowing that each number word is generated by adding one to the previous number (called the successor function or succession), and it means knowing that all and only sets whose members can be placed in one-to-one correspondence have the same number of items. (p. 1493)

This passage puts the meaning of what it means to understand numbers in terms of relations with other descriptions of what is known. Yet, it fails to provide a valid way of distinguishing rote
The discursive functioning of knowledge claims in research studies

from true conceptual knowledge. What does “knowing that each number word is generated by adding one to the previous number” refer to? As the previous argument showed, behavioral criteria are not enough. Is the knowledge supposed to be understood as a set of statements or contents that is somehow neurally encoded? Insofar as a statement or content could be memorized, this cannot be the criterion for conceptual knowledge. Does it instead mean that the person would say these things about him- or herself (i.e., I know that each number word is

5 It is important to stress that not all claims about numerical knowledge are problematic. In everyday contexts, a person may be described as “knowing how to count” or “understanding counting” in a way (i.e., in a context) that has important practical utility in specifying a person’s capacity for actions that are normative in a certain community of practice. In more concrete terms, we might imagine a preschool teacher, speaking to another teacher, who describes a student as knowing how to count. This might be done in preparation for some sort of activity in which counting is mutually understood to play a certain role. In this type of context, the claim has a clear utility. For example, the teachers might be concerned with whether the student in question could be expected to perform the activities typical of the game. Claiming that a child knows how to count would therefore be interpretable in terms of this context of activity. The precise delineation of the term would be irrelevant.

The use of knowledge claims becomes problematic when researchers attempt to generalize them beyond their highly contextualized everyday use, making them the focus of a scientific investigation that aims to determine (conclusively) whether children actually understand counting. The differences between these and everyday uses are crucially important. They involve a reversal of the relation between the knowledge claim and the capacity for action. In everyday uses, knowledge claims are meaningful in terms of their implications within a community of practice, i.e., in terms of a delimited set of activities that a member of the community would be expected to perform. In the cognitive development research reviewed here, there is no sharply delimited set of a few normative practices common to a community. Instead, as the previous research shows, researchers assess a child’s knowledge of number or counting in terms of a continually expanding (and, in principle, unlimited) set of possible normative uses of counting. In the cognitive development research, the issue of whether or not a child understands counting is not one determined by their capacity to normatively engage in a small number of normative practices in a particular community. Rather, it is determined by whether or not they show a capacity to normatively engage in virtually any variation or permutation of the basic counting activity. In summary, whereas the claim that a person “knows how to count” may be meaningful within a community where certain forms of counting are normative, researchers studying children’s number use have intentionally conceived of new, relatively novel situation in which to test children’s number use, and by extension, their counting. As a result, there is no clearly defined space onto which claims about children’s knowledge of number can be meaningfully fielded.
The discursive functioning of knowledge claims in research studies

generated by adding one to the previous number (which, by the way, is something that researchers generally have not expected children to do. This also doesn’t seem to be a sufficient criterion for knowing. One could claim to know X, despite being conventionally seen by others (possibly including developmental researchers) as not knowing X.

2.5 Towards an Alternative Approach to Knowledge

So far, researchers’ attempts to determine when (or for a particular age or ability level, whether) children come to understand number have been driven by the assumption that behavioral data pertaining to children’s use of numbers can address this issue. Insofar as it is unclear what type of findings would conclusively demonstrate true conceptual competence, it is unclear how continued behavioral research could ever answer the question of when children actually understand number. This suggests that another approach is needed. What type of alternative approach could shed light on these questions?

If continued behavioral research has raised problems that it cannot address, this suggests that the problems may have to do with the classificatory and analytical schemes used in the research itself, i.e., with the concept of “understanding numbers”. It may be that the difficulty in determining when children come to understand certain things about numbers may be a result of the way that concept itself is used or formulated in research.

These issues may be usefully addressed by taking a step back and reconsidering the issue of ‘knowledge of number’ from a very different perspective. One way to do this is to move away from the assumption that knowledge claims describe entities that exist independent of language (i.e., that exist independently of the discourses in which they are talked about). As an alternative, we may consider how descriptions of what a person knows are intrinsically discursive phenomena that exist in language, and are constructed through social interaction and social consensus. From this perspective (which is described at length in the next section), the issue of whether or not a child understands particular things about numbers is nothing more than a matter of whether or not it would be in line with typical practices of language use to say
The discursive functioning of knowledge claims in research studies

that they understand these things. In this way, knowledge of numbers might be understood in a way that is similar to the value of money. Just as currency tokens have value to the extent that they are treated as having value, children have knowledge to the extent that they are claimed to have knowledge.

One objection to this argument would be that the child’s knowledge cannot be socially constructed, since the abilities and competencies that the child can display are there regardless of whether or not they are recognized or talked about. These abilities are a matter of the dynamics of the child’s nervous system in interaction with its surrounding environment. Certainly this is not a social construction.

While it is certainly true that the child's competencies are, in some sense, still there, even if people cease to describe them as such, it is also true that to say anything about these competencies (indeed, to say that they are competencies in the first place) can only be done with language. Therefore, claiming that knowledge is discursive is to claim that knowledge cannot be characterized or conceptualized except through language, and that the meaning of any claim about what someone knows is a function of the consensual construction of meanings through language use--i.e., agreements about how certain words or phrases are used. These ideas are elaborated in the area of psychology known as discursive psychology, which is described in the following section.

2.5.a Discursive Psychology

Discourse is defined in different ways by different authors. In general (and for the current purpose) it maybe understood as referring to the patterned language use of a specific community context, or as a “a conceptual generalization of conversation” (Discourse, n.d.). A discourse (singular) refers to a conversation in a general sense that covers any set of utterances linked by addressivity. For the present purposes, an utterance may be loosely defined as a discrete statement, while addressivity refers to the way that an utterance functions as a response to some previous utterance (see Bakhtin, 1986) for a more comprehensive and
The discursive functioning of knowledge claims in research studies

subtle explanation of both terms). The analysis of discourse covers a wide variety of investigations of various dimensions of language including the personal and interpersonal processes through which language is used to construct arguments, ideas, concepts, identities, values etc.

The study of discursive phenomena partially encompasses the study of what might be called *semiotic* phenomena. The words *semiotic* and *discursive* are used to refer to different, albeit interrelated aspects of the functioning of knowledge claims. A *semiotic* analysis is an analysis of the ways that words like *knowledge* function as meaningful signs: what they mean and why they have this meaning. A *discursive* analysis describes a wider variety of analyses of language. While discourse analyses may be focused on the referential (semiotic) or expressive aspects of language, they may be concerned with other dimensions as well, such as the ways that arguments or values are constructed and negotiated, through narrative and other forms (for more information and examples of related work, see Bamberg and Andrews (2004), Daiute and Lightfoot (2004); Edwards (1997, 1993), Foucault (1972), Garfinkel (1967), and Potter and Wetherell (1987)). For the sake of simplicity, the term *discursive* will be used to refer to the type of analysis used in the current study, with the implication that the specific dimensions of discourse at interest here may be elsewhere addressed under the label *semiotic analysis*. Additionally, it should be noted that the analysis conducted in the current study is by no means representative of all (or even most) work done under the label “discourse analysis.”

Another term that is closely related to, and relevant for understanding discourse is *normativity*. To say that something is normative is, in the present context (see Bickhard, 2003 for a broader definition) to say that it is seen as appropriate or correct in terms of the established conventions of a particular community. For example, the use of a particular word (*dog*) to refer to the canine animal would be normative for most English speakers. In a discourse, certain features may be identified as normative, meaning that they constitute appropriate (relative to some community) uses of language.
The discursive functioning of knowledge claims in research studies

*Discursive psychology* (DP) emphasizes the discursive nature of much human reality, and seeks to show how many psychological questions may be addressed through the study of discourse on account of the fact that folk-psychological concepts such as knowledge, beliefs or attitudes are discursive constructions. To understand these concepts, we must look to the discourses in which they are constructed and elaborated. More specifically, if we wish to understand what knowledge, beliefs, or attitudes are, we must study the discourses in which these words are used. As this implies, in DP discourse is not treated as a mirror of the discourse-independent world, and discursive psychologists do not study discourse as if it provided a proxy for understanding the discourse-independent world. To do so would be (from the perspective of DP) to commit a category error. Instead, discourse is treated as a quasi-autonomous level of activity (where meanings are constructed, modified, and negotiated) that can be studied on its own terms for its own sake. These claims are elaborated by Edwards, who claims that discursive psychology is

not the study of the concepts, memory, and thinking, as revealed in discourse. Rather it is the study of discourse itself, which includes as part of its business how participants deal with those matters. Discourse analysis studies the nature of descriptions, versions, reports, formulations about the mind and world, and so on, in terms of the situated, communicative actions that they perform. It inverts the psychologist’s question about underlying competence from “What are the real thoughts, real concepts, real memories that underlie versions?” to, “What is the psychological basis of all this talk-as-action?” Note that once the inversion is done, we cannot just bolt it onto the original question; it is not a separate topic, another brick in the wall of knowledge. With regard to children’s conceptual thinking, for example, it is not clear that they “really think” anything, at least

---

6 This claim hinges on the philosophical distinction between reasons and causes, as elaborated by Ryle (1949), and more implicitly, but also more thoroughly in the later work of Wittgenstein (1953; 1981). An explanation of this distinction, and its relation to DP can be found in Appendix 1.
The discursive functioning of knowledge claims in research studies

not in the sense of carrying around in their heads ready-made explanations that merely await discursive opportunities to be revealed. (Edwards, 1993, p. 219; see also Harré and Gillette, 1994).

From the perspective of DP, claims about knowledge are not more or less valid or accurate based on the extent to which they mirror extra-discursive cognitive phenomena (which is not to say that they lack any intricate relationship with extra-discursive phenomena). Rather, particular ways of talking about knowledge can be valid or invalid as a function of whether they are normative (i.e., acceptable or appropriate in terms of the conventions of a particular community). Consideration of whether or not an utterance is normative means to consider whether it is seen as appropriate (i.e., the right or correct way of speaking), and as conforming to an unarticulated pattern set by previous utterances. So, from a discursive-psychological perspective, we would not assess the validity of a particular claim about a child’s knowledge (e.g., she knows how to count) in terms of whether it accurately represented the child’s inner cognitive structures, but in terms of whether and how it constitutes a normative way of talking about knowledge.

A cognitive realist who treats entities like beliefs, knowledge, as discourse-independent phenomena might respond by arguing that, while it is literally true that scientific conclusions about what children know are dependent on the ways language is used (since if language were used in other ways, a given conclusion would be formulated differently), this point is trivial since language is simply a mediator between the investigator and the actual phenomenon of study. To claim that scientific conclusions are determined by the way that language is used would be, in some ways, like saying that the meaning of what someone says on the phone is a function of how the phone works. The cognitive realist might argue that, although language is used to express conclusions about children’s knowledge, the truth of these conclusions is not just a function of whether they constitute a normative use of language, but of how accurately these uses describe the entities that this knowledge-talk is about: e.g., how accurately they describe some structural aspect of the nervous system. If children’s knowledge has no existence outside
The discursive functioning of knowledge claims in research studies

of language, how, one might ask, are children able to do what they do? If knowledge is simply a social construction, why do children have a different set of capacities than adults, infants, or other animals?

This cognitive realist line of thinking is correct in asserting that there must be some causal explanation for the way that an organism is able to interact with its environment. Its error is in the assumption that the causal processes constituting an organism’s interaction with its environment are isomorphic with the structures and/or processes distinguished by folk-psychological concepts (knowledge, attitudes, beliefs, etc.). (This error can be illustrated, in the case of the concept of knowledge, with the claim s/he did X because s/he knew Y, being interpreted to mean that Y (the knowledge) literally caused her action to unfold in the way that it did.) While this approach may appear to eliminate mind-matter dualism by treating psychological concepts as denoting causal entities in the physical world, it brings up problems. In using folk-psychological concepts (specifically knowledge) to provide a causal account of behavior, the possibility that these concepts are not reducible to the underlying structures and processes of the organism is overlooked.

Although for some purposes the idea of language as a mirror of extra-discursive reality is a useful metaphor, it is incorrect to deny that the only distinctions, equivalences or demarcations that can be made in language are those that already exist in the world beyond language. The distinctions made in language reflect its use in goal-directed human interactivity, where it provides a set of tools for doing things, rather than merely being a decontextualized and objective map of the world. Statements about someone’s knowledge of number are therefore necessarily more than depictions of brain or cognitive phenomena. They embody distinctions that originate in the forms of life—the varieties of cultural practices, of human interaction—which cannot be reduced to the individual organism (or even to an extended conception of the organism, including tools that are integrated into processes of activity).
The discursive functioning of knowledge claims in research studies

These issues are particularly relevant to the social sciences, which often involves concepts that are more discourse-dependent (intensional) than the concepts of the hard sciences. This can be shown with the following example. While the use of the word granite is strongly shaped by direct phenomenological interactions with granite rocks as a discourse-independent entities and can be given an ostensive definition, this is less apparent in the case of knowledge. We may interact with people (who, we may claim, know things), but we cannot point to the knowledge itself. Or to the extent that we can, we will be pointing to something much less discrete (in sensory-motor terms) than we would in the case of ostensive pointing to a piece of granite. Even if we claim, as Chomsky did, that knowledge can be identified with some structures or processes in the brain (Chomsky, 1988), our relative ignorance of these structures and processes, and our lack of direct experiences with them, limit the extent to which the concept of knowledge can be extra-discursively grounded in these structures or processes.

The perspective of discursive psychology provides a possible way to understand the issues that emerged in the previous analysis of literature. For example, it can readily account for the issue of conclusively determining what a child knows about numbers, since this would be understood as akin to conclusively determining whether or not a certain picture is pretty, or the precise moment at which someone becomes an adult. These are simply discursive claims that are made, whose validity is never solely a function of the structure of the extra-discursive world, but of received ways of talking about knowledge, beauty or adulthood. From the discursive perspective, we could make sense of these claims by looking at the ways that they are made, justified, undermined, and otherwise negotiated.

Some existing research has been done in the discursive psychological tradition (broadly construed) on topics relating to knowledge, and specifically children’s conceptual knowledge—including, in some cases, numerical knowledge (e.g., Edwards, 1993; Lampert, 1990; Sfard & Lavie, 2005). However, these investigations (see also, Nelson and Nelson, 2002; and Saxe and Esmonde, 2012) have been focused on discursive interactions that are taken, from the outset,
The discursive functioning of knowledge claims in research studies
to implicitly constitute knowing—i.e., (inter)actions that in a particular setting might be normative
grounds for claiming that someone knows something (e.g., about numbers). For example, both
Nelson & Nelson (2002) and Saxe and Esmonde (2012) show the interdependence between the
competence of members of a certain cultural community, and the symbol systems and other
technologies that support these competencies and their evolution into new forms. This work
foregrounds those practices themselves, developing across historical time and through the
influence of changing cultural values and tools. While these topics are important in their own
right, they are different from the focus of the current research, which is on the discursive
functioning of knowledge claims themselves, claims about what someone does or doesn’t know,
as well as a central component of this discourse, the signs to know and to understand, and their
objectified (Sfard, 2008) form knowledge and understanding. Here, the focus is not on the
activities that are assumed to be relevant to or constitutive of knowledge (e.g., children’s uses of
counting and number words), but on the claims made about knowledge on the basis of such
activity, and the ways that various forms of the words knowing and understanding function
discursively.

2.5.b Rationale for the Study of Knowledge Claims

Insofar as knowledge is constructed in discourse (i.e., insofar as it is a discursively
constructed object) what is said about it is always a matter of consensus. Therefore, the
meaning/use of knowledge claims is inherently variable, at least in principle. The way that a
particular knowledge claim (e.g., s/he understands counting) is used is a matter of historical
consensus; it is a function of how this claim is normatively used by people in social interactions.
Therefore, phrases such as he understands counting have no inherent meaning or referent that

---

7 Something is normative if it is perceived, without explanation, as correct or appropriate. According to Baerveldt and Verheggen (2007) “Normativity in the realm of everyday conduct involves implicit standards for the correctness and appropriateness of actions and expressions.” (p. 175)
The discursive functioning of knowledge claims in research studies

precedes, anchors or provides a guide for their use. This idea is applied to the concepts of the social sciences by Slunecko and Hengl (2007) who write,

For discourse analysts, things such as the state, madness, religion, humanity, freedom, and so on may be understood solely out of the discursive practice that created them at a particular point in time. These things have no essence and continuity as such; if they had, different times and cultures would have no choice but to come to terms with them, that is, to react to their given existence with specific practices. To handle these things does not mean to respond to some continuous natural essentials. Instead, these things (state, religion, madness, etc.) are to be explained out of our discursive practice – and never the other way around. (Slunecko & Hengl, 2007, p. 48)

While Slunecko and Hengl’s point is made with respect to things like madness, religion and the state, the point applies just as well to the concept of knowledge. Given this, it is particularly striking that scientific investigations would attempt to investigate topics like what a person knows. Insofar as knowledge claims are discursive phenomena (i.e., consensually and normatively determined), the criteria for reaching conclusions in these investigations (and the conclusions themselves) are only as stable as the discourse within which the investigation is carried out. Stated in another way, what it is that a person knows is essentially a matter of what people normatively treat him or her as knowing.

The possible instability of the discourses that frame and constitute scientific investigations has the potential to completely undermine any pretense of objectivity in the research that is built on these discourses. How can a definitive scientific conclusion be reached if the conclusion is “built” out of concepts with inherently variable meanings, and no historically stable point of reference? This issue is not resolved by ensuring that research questions are addressed through careful empirical investigation. So long as the research questions are about

\[ \text{\underline{8}} \quad \text{In the case of knowledge, rather than attempting to explain what knowledge the child} \quad \text{really has, the alternative suggested by Slunecko and Hengl is to study the discourses within which it becomes possible to claim that the child has knowledge in the first place.}\]
The discursive functioning of knowledge claims in research studies

abstract discourse-dependent objects (e.g., concepts like *knowledge*), no amount of empirical support for specific findings can guarantee a stable or final conclusion. Slunecko and Hengl make this point forcefully, arguing that,

Because madness or sexuality … are not natural entities, but discursively constructed ones, there is no point for science to go asking people about their attitudes toward these objects. Rather, science has to analyze the discursive practice, by which madness or sexuality emerge in their specific historical appearances. This critique blatantly affects human and social sciences, as long as they thoughtlessly take their starting point from the false entities and overlook the process of their creation. The methodical consequences of that critique are cogent: when asking people about their attitudes, judgments, or opinions on madness, beauty, sexuality, and so on, that is, about their beliefs on false entities — an endemic practice in psychology — all one does is corroborate the faith in false objects. Instead of trying to leave the illusionary circle, one ultimately ends up substantiating and reproducing the dominant discourse and ideology. (Slunecko & Hengl, 2007, p. 48)

While this argument has important implications for the social sciences, the fact that discursively constructed objects (e.g., knowledge, but also madness, sexuality, etc.) have been studied as if they were—to use Slunecko and Hengl’s term—“natural entities” is something that demands explanation, since from the discursive perspective, such investigations make very little sense. As the previous literature review showed, an abundance of studies have attempted to draw conclusions about what children know about numbers. If there is no knowledge “out there” to study (apart from the use of the word *knowledge* in discourse), how are such conclusions possible?

To understand how conclusions about what children know are made, the central phenomena of interest are the ostensibly definitive conclusions about what people know — along with the ways that these conclusions are justified. How do these claims function — specifically,
under what circumstances is their assertion considered valid/invalid? These questions may be answered by analyzing the discourse in which such conclusions are asserted, contested and justified, such as might be reflected in the text of research articles on children’s conceptual knowledge. Analysis of such articles could reveal how knowledge claims function within a system of interrelated semiotic components that relate according to a particular discursive logic: in other words, a language game (Wittgenstein, 1951) or speech genre (Bakhtin, 1986).

2.5.c Interpretive Approach

Of course, in such an analysis of research texts, the number of relevant features would be essentially infinite. Any discourse, or aspect of a discourse (such as conclusions about knowledge), functions the way it does (i.e., has the meaning that it does) by virtue of a practically infinite number of features. Besides the words themselves, there is the context in which they are spoken/written/read (e.g., what has been previously stated, or the location of the text in some larger publication) and their physical characteristics (e.g., font/tone). Furthermore, the functioning of all of these is affected by further historical and contextual factors.

The later work of Wittgenstein shows that contextual factors that are involved in meaningful language use are not only numerous, but also a vital precondition for meaningful language use. Wittgenstein’s view of language is fundamental for the current research. According to this view, (1) language is always understood as language use; and (2) this use is always intentionally communicative in nature, as opposed to being separated from the context of intentional communication. The implication of (2) is that language is always being used in the context of two or more specific people, with certain perspectives and certain assumptions, including certain assumptions about what the other assumes. Building from the last point, (3) any instances of language use (utterances) are only intersubjectively meaningful against a shared background that Wittgenstein calls a form of life (Wittgenstein, 1953), which is akin to the notion of a habitus (Taylor, 1977, drawing on Bourdieu, 1977), and cannot be comprehensively articulated. As he shows in his later work (Wittgenstein, 1953, 1979, 1981) it is
The discursive functioning of knowledge claims in research studies

not possible for the intended implications or meaning of any utterance to be unambiguously
determined in terms of the explicit features of the utterance itself. For a summary of these
arguments, see Appendix 1.

The arguments in Appendix 1 show that the existence and functioning of knowledge
claims cannot be fully accounted for in terms of the explicit features of texts or other
communicative expressions, and that extra-discursive aspects of language (e.g.,
intersubjectivity, shared assumptions, and mutual participation in particular forms of life) provide
its fundamental grounding and are necessary to explain its use. These relevant extra-discursive
aspects of language are essentially infinite in number and complexity. While a full cataloguing of
them would be necessary for a fully comprehensive account of how knowledge claims function,
the current research aims to show how the functioning of knowledge claims may be usefully if
not comprehensively elucidated solely through the analysis of a relatively small number of
explicit features of the discourse in which these claims are made (specifically, as this discourse
manifests itself in peer reviewed and published research articles).

So, rather than comprehensively analyzing the functioning of knowledge claims, the
analysis in the current research starts from the assumption of approximate intersubjectivity with
the authors/editors of the analyzed research texts. In this approach, the identification of
knowledge claims is the starting point for the analysis, rather than its ultimate goal.
Consequently, this approach will not provide a complete account of knowledge claims and their
functioning: e.g., it will not fully explain why a given utterance is interpreted as a knowledge
claim as opposed to anything else discursively.
CHAPTER 3. GENERAL FOCUS OF THE CURRENT RESEARCH

3.1 Research Question

The current research examined how conclusions about what children know about number are asserted, justified, and contested. For instance, when a researcher claims that a child understands the cardinal principle, on what basis is this claim validly asserted, what are its implications, and if its assertion is contingent on some sort of evidence, what makes that evidence valid/invalid?

3.2 Sites of Analysis

To answer these questions, the current study analyzed texts of peer reviewed published articles on children’s understanding of cardinality. While these texts are not a full record of the use of knowledge claims in the entire research process (not to mention in the discursive community within and with respect to which such claims are made), they are sufficient for the goals of the current analysis for several reasons. First, the texts include descriptions, explanation and analysis of previous research (i.e., part of the discursive context), the statement and justification of research questions about children’s knowledge, the description and justification of methods for addressing these questions, reports of the results of empirical observations, and conclusions drawn based on the results. Secondly, since these articles are produced in relative isolation from their intended audience, details may be made explicit which are relevant to the current analysis that would otherwise be unmentioned. As a result, it is hoped that published research articles will provide a sufficient record of the general discursive logic through which conclusions about what children know are reached.

3.3 Initial Analytical Categories

The goal of the current research is to model the components (and their interrelations) of the discursive processes through which conclusions are reached about what children know. While this model will be developed based on the analysis of published research texts, it is necessary to begin the analysis with several assumptions about these components and their
The discursive functioning of knowledge claims in research studies

interrelations. Without such initial categories, the analysis could not be conducted. The two categories described below are the initial categories used to guide the analysis.

3.3.a Knowledge claims

Knowledge claims refer to descriptions of what a person does know, doesn’t know or may know. Knowledge claims are not just claims about the presence or absence of knowledge in some broad sense, but rather claims that describe what is known. For example, the following would be considered knowledge claims:

• s/he knows that each number word refers to a set of items, rather than any one of its individual members.

• s/he understands how counting works

• s/he knows that the sequence of counting words must be repeated in the same order

• s/he knows that each number spoken while counting must be applied to one and only one item in the counted set.

• s/he knows the principle of cardinality [descriptions of what cardinality is that are given or referenced elsewhere in the text would be considered a part of this knowledge claim].

Statements that are phrased in different ways may still be considered knowledge claims, so long as they are, in some way, a description of what is known. So, for example, if in any of the above examples, the word knows was replaced with understands, grasps, realizes, comprehends, or if the child were claimed to have the concept of any of the above predicates, these would still be considered knowledge claims. Additionally, while the above examples involve claims about what a child does know, claims about what the child doesn’t or may know were also treated as knowledge claims, e.g., the claim that s/he doesn’t understand cardinality would be considered a knowledge claim.

Claims about knowledge that are not claims about what is (or isn’t/may be) known are not considered to be knowledge claims, since these are not assertions about what it is that a
The discursive functioning of knowledge claims in research studies

person knows. For example, the phrase *knowledge is important* would not generally function as a knowledge claim.

Finally, while statements of knowing-how and knowing-that have been distinguished in other work, especially in philosophy (Ryle, 1949), both types of statements will be considered knowledge claims for the current purposes. This is not meant to imply that there is no difference between them, but that both fall under the umbrella of knowledge claims, even if within that category, they function in different ways. If, in the analysis of knowledge claims, claims of knowing-how function in systematically different ways from knowing-that, then these differences will be incorporated into the general model of the discursive functioning of knowledge claims.

3.3.b Justifications

A *justification* is any statement that serves to justify the actual or conditional assertion of a knowledge claim. In other words, a justification is the direct reason given for asserting a knowledge claim, with the consequence that, had the justification not been given, the assertion of the claim would be considered invalid. For instance, if it is claimed that a child *understands how counting works* because they can pass the Give-N task, (i.e., to correctly construct sets of a requested number of items for any number up to six) then *passing the Give-N task* (and any included or referenced description of what this entails) would be considered the justification. To further illustrate the analytic category of *justifications*, the following artificial examples (not from actual texts) show statements with the knowledge claims in italics, and the justifications underlined:

- *s/he doesn’t understand how counting works* because *when asked for “four toys” from a larger pile, she responded by grabbing a random number of toys.*
- *s/he has a concept of cardinality* because *she passed the Give-N task.*
- *After an experimenter removed an item from a previously counted set, s/he correctly responded when asked how many items it now contained,* suggesting
The discursive functioning of knowledge claims in research studies

that s/he knows the subtraction of an item from a counted set means that the
number of items in the set decreases by one.

• Passing the give-N task involves correctly giving out any requested number of
items from a larger set … s/he passed the Give-N task. … [therefore] We can
conclude that she understands the cardinal principle.

3.4 Locating Knowledge Claims and Justifications in Scholarly Research Reports

In the current research (and in the previous explanation of the analytic categories),
certain statements are identified as exemplars of knowledge claims or justifications. The
identification of discrete statements as exemplars of these categories is somewhat misleading.
These categories do not demarcate discrete features of the text. As is true for any other
meaningful statement, a knowledge claim or justification exists as such because of its relation to
the surrounding text or utterance. So, while a particular statement can be identified as a
knowledge claim or a justification, the meaning of this statement is partially constituted by other
statements, whose meaning is in turn constituted by other statements. For this reason, it is not
always possible to make a clear distinction between parts of the text that are and are not
knowledge claims or justifications.

While knowledge claims and justifications will be treated if they are exemplified by
discrete statements, these examples should be interpreted as abstractions from the text as a
whole, rather than discrete parts of it. So, when a statement is extracted from a text and labeled
as a knowledge claim/justification, the knowledge claim/justification in question is not literally the
statement itself, but rather a property of the discourse as a whole that is particularly salient in
the extracted statement. For example, if it is claimed that a child understands cardinality
because they pass the give-n task, then passing the Give-N task would be the most directly
given reason (justification) for the claim, but descriptions of what this task is, what a passing
performance entails, and why it is relevant, would all be a part of the justification as well.
Similarly, if a knowledge claim is justified with a citation for another research article, the relevant parts of the cited text would be considered an indirect part of the justification.

The difficulty of demarcating justifications from other parts of the text is anticipated to be particularly acute in the method and results sections of articles. In these sections, details that will ultimately furnish the justifications of knowledge claims will be discussed in great detail, and referred to in various direct and indirect ways. Whereas in certain sections, it may be possible to identify rather discrete statements as embodying knowledge claims and justifications, the depth of discussion of justifications in the method and results sections will preclude this.

3.5 Goal of Analysis: A Model of the Discursive Functioning of Knowledge Claims

In the current study, the categories of knowledge claim and justification will be used to analyze a sample of research texts in order to refine the categories themselves, as well as to better understand their interrelations. The ultimate goal of this analysis is the construction of a model depicting the discursive functioning of knowledge claims, from here on referred to as the model of knowledge claim functioning or simply the model for short. To develop the model, the initial categories of knowledge claim and justification will be refined, developed, and elaborated with additional categories through the analysis of multiple articles, eventually resulting in the final model.

The model will provide an account of the functioning of knowledge claims that answers the following questions: Why does a particular justification provide a valid or appropriate (as opposed to irrelevant) reason for asserting/contesting a particular knowledge claim? On what basis are the justification and the knowledge claim related? Is there an argument given to substantiate this relationship, or any explanation for why the justification brought to support a knowledge claim does in fact provide grounds for making this claim? If so, how do the arguments work? Are they part of the justification? If not, why are they necessary? Overall, what

---

9 From the standpoint of the author, or their assumed audience.
The discursive functioning of knowledge claims in research studies

do they say about the functioning of knowledge claims, and the relation between a claim and its justification?

3.6 Methodology

3.6.a Process of Analysis

The present research involved the analysis of the discursive functioning of conclusions about what children know about numbers and counting (knowledge claims) in a selection of 13 published research articles. The text analysis is unique in that its final product (the model) is a refined, developed and elaborated version of the categories used in the analysis themselves—which at the start of the analysis were just the previously described knowledge claims and justifications. The text analysis and development of the model occurred through the following steps:

1. Preliminary analysis of one initial text using the initial categories (knowledge claims and justifications).
2. Refinement and elaboration of the categories and their relations to produce a rough prototype model of knowledge claim functioning.
3. An iterative process in which additional texts were analyzed to determine their fit to the model, and the model itself was changed to accommodate to previously unaccountable aspects of knowledge-claim use. These two phases followed each other in a repeated fashion as updated versions of the model were assessed for their fit to a gradually broadening selection of texts. This continued until saturation was reached: i.e. until the analysis of new texts—including texts from diverse journals and different historical areas—ceased to require changes to the model.

3.6.b Selection of Texts for Analysis
The discursive functioning of knowledge claims in research studies

Texts included in the analysis were edited, peer-reviewed and published research articles on children’s knowledge of numbers and counting. These were focused on the following questions:

1. When do children understand the cardinal principle?
2. How can we better characterize children’s knowledge of the cardinal principle?
3. When do children know that the last word reached in counting represents the cardinality (i.e., number of items) in the counted set?
4. What do children at age $X$ know about the cardinal properties of numbers?

The sampled texts (selected according to a rationale described below) are listed in Table 1 (below).
The discursive functioning of knowledge claims in research studies

Table 1. Texts included for analysis in Study 2

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Journal</th>
<th>Year</th>
<th>Pgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rochel Gelman</td>
<td>Logical Capacity of Very Young Children: Number Invariance Rules</td>
<td>Child Development</td>
<td>1972</td>
<td>15</td>
</tr>
<tr>
<td>Rochel Gelman</td>
<td>Preschoolers’ counting: Principles before skill</td>
<td>Cognition</td>
<td>1983</td>
<td>16</td>
</tr>
<tr>
<td>Elizabeth Meck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diane Briars</td>
<td>A Featural Analysis of Preschoolers’ Counting Knowledge</td>
<td>Developmental Psychology</td>
<td>1984</td>
<td>17</td>
</tr>
<tr>
<td>Robert S. Siegler</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catherine Sophian</td>
<td>Early Developments in Children’s Understanding of Number: Inferences about Numerosity and One-to-one Correspondence</td>
<td>Child Development</td>
<td>1988</td>
<td>19</td>
</tr>
<tr>
<td>Douglas Frye</td>
<td>Young Children’s Understanding of Counting and Cardinality</td>
<td>Child Development</td>
<td>1989</td>
<td>13</td>
</tr>
<tr>
<td>Nicholas Braisby</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>John Lowe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celine Maroudas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jon Nicholls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karen Wynn</td>
<td>Children’s Understanding of Counting</td>
<td>Cognition</td>
<td>1990</td>
<td>37</td>
</tr>
<tr>
<td>Neon Brooks</td>
<td>Inference and Number Words</td>
<td>Developmental Psychology</td>
<td>2012</td>
<td>9</td>
</tr>
<tr>
<td>Jennifer Audet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>David Barner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kathryn Davidson</td>
<td>Does Learning to Count Involve a Semantic Induction?</td>
<td>Cognition</td>
<td>2012</td>
<td>11</td>
</tr>
<tr>
<td>Kortney Eng</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>David Barner</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ana Nikoloska</td>
<td>Development of the Cardinality Principle in Macedonian Preschool Children</td>
<td>Psihologija</td>
<td>2009</td>
<td>16</td>
</tr>
<tr>
<td>Barbara W. Sarnecka</td>
<td>How counting represents number: What children must learn and when they learn it</td>
<td>Cognition</td>
<td>2008</td>
<td>12</td>
</tr>
<tr>
<td>Susan Carey</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barbara W. Sarnecka</td>
<td>The idea of an exact number: Children’s understanding of cardinality and equinumerosity</td>
<td>Cognitive Science</td>
<td>2013</td>
<td>13</td>
</tr>
<tr>
<td>Charles E Wright</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kevin Muldoon</td>
<td>Putting counting to work: preschoolers’ understanding of cardinal extension</td>
<td>International Journal of Educational Research</td>
<td>2003</td>
<td>26</td>
</tr>
<tr>
<td>Charlie Lewis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norman H Freeman</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bob Bruce</td>
<td>One, Two, Three and Counting</td>
<td>Educational Studies in Mathematics</td>
<td>2004</td>
<td>24</td>
</tr>
<tr>
<td>John Threlfall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The selection of these particular texts was guided by the following considerations. First, the original impetus for the current research arose out of issues in recent studies of children’s understanding of counting and numbers. Insofar as the goal of the current research is to address these issues through a study of the discursive functioning of knowledge claims, studies on children’s understanding of cardinality provide an appropriate place for doing so. Therefore, the sample includes studies that were prominently analyzed in the literature review including Sarnecka & Carey (2008), Wynn (1990), as well as articles that address similar topics (e.g.,
The discursive functioning of knowledge claims in research studies

Fuson, 1992; Sarnecka & Gelman, 2004; Sarnecka & Wright; Sophian, 1992). The studies by Brooks Audet and Barner (2012) and Davidson, Eng and Barner (2012) are also included because they are direct responses to some of the previously mentioned studies, and provide counterarguments to their claims regarding what children know about number.

To assess the degree to which findings regarding the discourse on knowledge observed in these more recent articles can be generalized beyond these texts (and to further refine the model to evaluate its validity), several older articles will also be analyzed. These articles, from the 1970’s and 1980’s are focused on the same general issue as the others—children’s knowledge of numbers and counting—but arose out of a different historical context. The choice of the specific older articles was driven by their (1) topical similarity to the topics analyzed in the more recent articles (to avoid having to re-introduce unfamiliar concepts) and (2) prominence in the field of research on children’s numerical knowledge (these articles are frequently cited in studies of children’s numerical knowledge, including in the more recent articles analyzed in the present research).

The choice of texts from different historical points is anticipated to introduce differences that will challenge the model and possibly allow it to be further refined. Shifts in historical context amount to shifts in what can be taken for granted, what is assumed to be understood, what must be explained—i.e., assumptions about the audience. These differences will be attended to and explored, but only as they bear on the general model of how knowledge claims function with respect to the normativity of a particular community. In other words, by examining texts from different eras, the goal is not to say something about these eras, or to explain differences in the texts in terms of already-known historical changes. Instead, the goal is to introduce diversity into the selection of analyzed texts, allowing the model of knowledge claim functioning to be tested in the context of (possibly) very different texts.

The selection of texts also includes more than one text from several different journals. Specifically, Sophian (1988) and Frye et al. (1989) are from the journal Child Development.
The discursive functioning of knowledge claims in research studies

Sarnecka and Carey (2008) and Davidson, Eng and Barner (2012) are from Cognition. Finally, Bruce (2004) and Muldoon et al. (2003) are from educational research journals (Educational Studies in Mathematics and International Journal of Educational Research, respectively). The inclusion of multiple articles from the same journals was intended to facilitate comparison of the role of addressivity at the level of the journal, in order to enhance the validity of the generalizations about addressivity in the model. (Appendix 2 provides additional information from an analysis of addressivity-related differences across the texts analyzed in Study 2.)

References to quotes in each of these texts are given in terms of the following format: [page number; line number/range]. For example, [5; 4] would refer to p. 5, line 4. For quotes spanning multiple pages, the format is given as [page range; first-last line number]. For example, [5-6; 16-4] would refer to a quote spanning pages 5-6, from line 16 (on page five) to line 4 (on page 6).
The discursive functioning of knowledge claims in research studies

CHAPTER 4: STUDY 1: PRELIMINARY ANALYSIS OF SARNECKA AND CAREY ARTICLE IN TERMS OF INITIAL CATEGORIES

The initial text analysis, i.e., Study 1, used the initial categories of knowledge claims and justifications to analyze a single research article (Sarnecka & Carey, 2008), and in the process, to refine the categories in order to construct an initial model. The selected article is focused specifically on children’s knowledge of cardinality and their understanding of counting. Moreover, it is especially relevant to the question guiding the current research (How can a discourse object be the focus of scientific study that does not treat it as such?) insofar as the goal of the article is to determine “what children know [about cardinal numbers] and when they know it”, and to “characterize the knowledge [of cardinality] itself” (p. 662).

4.1 Identifying Knowledge Claims and Justifications in the Sarnecka and Carey Text

The analysis began by attempting to identify the initial categories (knowledge claims and justifications) with specific parts of the analyzed text. This required several careful readings of the text in order to clearly identify knowledge claims and justifications that were (a) distributed across the text rather than found only in one area, or (b) apparent as exemplars of either category only in terms of the wider text.

The passage below, which is actually from Schaeffer et al. (1974), quoted by Sarnecka and Carey (2008), provides a relatively straightforward example of what knowledge claims and justifications looked like in the text.

After the child had counted the chips, the line was immediately covered with a piece of cardboard and the child was asked how many chips were hidden. Evidence that he knew... [the cardinal principle] was that he could respond by naming the last [numeral] he had just counted. [3; 18-24]

In this quote, the categories of knowledge claim and justifications refer to the following statements:
The discursive functioning of knowledge claims in research studies

*Knowledge claim:* he knew... [the cardinal principle]¹¹

*Justification:* After the child had counted the chips, the line was immediately covered with a piece of cardboard and the child was asked how many chips were hidden. ... he could respond by naming the last [numeral] he had just counted.

Appendix 4 illustrates how knowledge claims and justifications were identified and analyzed in the Sarnecka and Carey text. That appendix contains a reprint of the Introduction section of the text, in which the statements that express or directly reference knowledge claims are highlighted, while the justifications are underlined. As knowledge claims and their accompanying justifications were identified, they¹² were entered into adjacent cells on a spreadsheet.¹³ The spreadsheet helped to keep track of each knowledge claim and justification, and facilitate understanding of these categories and their interrelationships themselves. Since each knowledge claim and justification could comprise multiple related excerpts from across the text, entries on the spreadsheet often cited more than one location in a text, in order to provide a more comprehensive representation a knowledge claim or justification. So, for example, in the case of the knowledge claim *understanding the cardinal principle*, its entry would include additional clarification (if provided by the text) describing what is meant by the cardinal principle. Likewise, if children claimed to *understand the cardinal principle* because they *passed the Give-N task*, the described procedure of this task would be included as a part of the justification.

¹¹ The cardinal principle is interpreted in terms of the authors’ immediately preceding description as “the recognition that the last numeral used in counting tells the number of items in the set”. [3; 17]

¹² The immediate text of a knowledge claim, and if necessary additional clarification, if available (e.g., in the case of vague claims such as *knowledge of the counting principles* which reference previously mentioned information)

¹³ This spreadsheet is included as Appendix 8. However, it is not presented here as an accessible presentation of data, but rather as an example of an initial tool used in the analysis.
The discursive functioning of knowledge claims in research studies

Because knowledge claims were often repeatedly referenced in ways that drew on previous explications, and because the degree to which they are explicitly present in the text ranges from claims that are only implicitly entailed\(^\text{14}\) to those that are fully explicit, it is not possible to report a discrete frequency count of knowledge claims. Another way of stating this is to say that the unit of analysis in this research is not a discrete feature of a text, but a discursive entity that is continually being reconstructed and elaborated by particular texts. A knowledge claim may be understood as a property of a particular discourse. While this property is not something that exists discretely in a particular place in a particular text, it is elaborated in particular places in texts, and therefore may be investigated as such.

Even if it were possible to report descriptive statistics, doing so at this point would be premature, because the categories in question remain underdeveloped. The goal of reliably and validly coding statements as knowledge claims or justifications drives the development and refinement of the analytic categories, which are reported in the following sections. Therefore, to report general conclusions about the first analyzed article in terms of these categories would be problematic at this point.

4.2 Initial Development of Analytic Categories

4.2.a Clarification of Knowledge Claim and Justification Categories

The results of the initial coding of the Sarnecka and Carey article made it necessary to slightly revise the initial categories of knowledge claims and justifications due to the flexibility and variability of statements that could be considered to exemplify either category. The most basic form of knowledge claim-justification pairings in the Sarnecka and Carey text was a description of some behavioral performance given as a direct reason for a knowledge claim,

\(^{14}\) For example, when Sarnecka and Carey (2008) consider the “principles-after view” of children’s number development, they are implicitly claiming that children understand the one-to-one principle, the stable-order principle, and the cardinal principle from the time they are early preschoolers. Such implicit mentions contrast with explicit mentions of these knowledge claims.
The discursive functioning of knowledge claims in research studies

such as the case illustrated in the previous example (i.e., Sarnecka and Carey’s quote of the Schaeffer et al., (1974) article [3; 18-24]) 1. While there were many other examples like this, in at least as many other cases, knowledge claims and justifications were identified that derived from this basic structure as transformed through the use of various linguistic devices.

A common derivation of the basic knowledge claim-justification structure is seen in cases where a task itself is mentioned as a measure of a given form of knowledge, as when Sarnecka and Carey ask “if the How-Many task doesn’t test understanding of the cardinal principle, what does it test?” [4; 5-6]. In the text analysis, this statement was considered to contain a knowledge claim (understanding the cardinal principle), a justification (the How-Many task), and an implied but unspecified knowledge claim (the “it” that is tested by the How-Many task). (It should be noted that in this case, per the quote, these were not paired with each other.) The How-Many task may not be immediately apparent as a justification, since it is not given as the reason for asserting any knowledge claim. Yet, deconstructing this statement shows it to be clearly derived from the basic knowledge claim-justification structure, as is shown in Table 2 below, which shows how a short question is shown to be expandable into three knowledge claim-justification pairings:
The discursive functioning of knowledge claims in research studies

Table 2. Deconstruction of a statement to reveal implicit knowledge claims and justifications

<table>
<thead>
<tr>
<th>Original statement</th>
<th>Deconstructed form of statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>if the How-Many task doesn’t test understanding of the cardinal principle, what does it test?</td>
<td>Understanding the cardinal principle</td>
</tr>
<tr>
<td></td>
<td>X (undefined knowledge, i.e., the answer to the question “what does it test?”)</td>
</tr>
<tr>
<td></td>
<td>Does not know X (the absence of some undefined knowledge; “what does it test?”)</td>
</tr>
</tbody>
</table>

Numerous instances of knowledge claims and justifications the text showed how the basic structures of knowledge claims and justifications could be transformed with great flexibility.

While these transformations often entailed complex uses of knowledge claims, analysis (such as that shown above for Table 2) revealed that these did not fundamentally depart from the basic structure. Still, to fully account for these transformations, it was sometimes necessary to broaden the categories of knowledge claim and justification to include the various possible transformations and derivations from their basic structures. The two initial ways in which this was done are listed below (incidentally, the features that drove these changes are both found in Table 2):

1. Knowledge Claims or justifications may be present only as undefined placeholders:

   Undefined placeholders are knowledge claims or justifications that are implied, but not explicitly defined or fully described. In Table 2, the question “…what does it measure?” indicates an undefined placeholder. As another example, the statement There is some form

¹⁵ Later on in the text, the undefined justification here is shown to be the Give-N task.

¹⁶ Later on in the text, this is stated explicitly as “a procedural rule about counting and answering the question ‘how many.” [6; 6]
The discursive functioning of knowledge claims in research studies

of knowledge that can be measured by some task contains undefined placeholders for its knowledge claim and justification.

2. Groupings comprising related knowledge claims or justifications may be formed: Groupings involve a set of either knowledge claims or justifications that may be combined and treated as a single knowledge claim/justification. There were two forms of this:
   a. Groups comprised of the presence, absence and similar variations of a given knowledge claim or justification. Examples:
      i. The set of typical performances on a task (passing/failing) that could be justifications for/against a given knowledge claim. The “measure” or “test” for a given form of knowledge may be considered to be a grouping of justifications.
      ii. The assertion and non-assertion of a given knowledge claim. For example, the claims that a person understands the cardinal principle or doesn’t understand the cardinal principle are grouped in knowledge of the cardinal principle.
   b. Groupings of related variations of a type of knowledge claim or justification. Examples:
      i. Children’s knowledge of the counting principles (this statement groups together knowledge of each individual counting principle).
      ii. Children’s performance on measures of counting skills (various counting tasks are grouped together).

Table 2 shows instances of both undefined placeholders (an undefined knowledge claim) and groupings (the set of possible performances on the How-Many task). Many more examples of each of these were identified in the text.

4.2.b New Analytic Categories

4.2.b.i Higher-Order Knowledge Claims. In the Sarnecka and Carey text, there were some cases in which knowledge claims involved more than just these basic categories of knowledge claim and justification. Although the basic distinction between knowledge claims and justifications was evident in these constructions, their unique qualities are worth mentioning, and
The discursive functioning of knowledge claims in research studies

these qualities were partially responsible for an additional analytic category derived from the
initial analysis: higher level knowledge claims. Higher-order claims are knowledge claims that
are made (i.e., asserted or contested) through the combination of multiple individual knowledge
claims, and possibly through the use of additional discursive devices. A simple example of a
higher level knowledge claim would be the claim that *children know x before they know y*, which
would be constructed on the basis of juxtaposing the age at which a child can normatively be
claimed to know x versus y.

Higher order claims were often reached by integrating individual knowledge claims in the
context of additional a reified or objectified (Sfard, 2008) notion of knowledge. In the case of
knowledge, *objectification* involves transitioning from talking about *what the child knows* to
talking about *the knowledge itself*. Sarnecka and Carey (2008) arrived at findings about
knowledge itself (as opposed to about what a child knows) by first identifying a child who was
claimed to have knowledge of the cardinal principle on the basis of performance on a task (the
Give-N task). Then, they used the child’s performance on a different task to draw conclusions
about the knowledge of cardinality itself using the claimed-to-know child as a proxy for the
knowledge of cardinality and relying on the assumption that the second task measured a
different aspect of the same body of knowledge. Additional examples of objectification and
higher-order knowledge claims can be found in Appendix 7.

Despite the use of objectification, or in other words, the shift towards conceiving of
knowledge as an object in its own right, these and other higher order knowledge claims still
function like the other claims in the text. Objectifying knowledge leads to different types of
conclusions or predictions being made (e.g., about the knowledge itself), but the basis on which
these predictions are made is only superficially different from what obtains in the basic model:
Claims about knowledge as an object are just made by identifying persons with the knowledge
they are claimed to have, and then treating future findings about their knowledge as if these
were findings about the knowledge itself, rather than about a person.
The discursive functioning of knowledge claims in research studies

While higher-level knowledge claims were frequently found in the analyzed texts, they will not be given special emphasis, since they are not fundamentally different from other knowledge claims in ways that are relevant to the current paper. So while these claims will continue to be analyzed where relevant, higher level knowledge claims do not appear to function in a special way but rather extrapolate generic knowledge claim discourse.

4.2.b.ii Explanations. There were several instances in the Sarnecka and Carey (2008) text in which the assertion of a knowledge claim on the basis of some justification was supported by arguments not readily categorizable as justifications themselves. These arguments—from here on referred to as explanations—supported the assertion of a knowledge claim indirectly by explaining why a given justification would (or would not) be valid grounds for asserting the knowledge claim. Explanations did not fit the category of justifications because they supported the choice of a particular justification as grounds for asserting a given knowledge claim just as much as they supported the implication of a particular justification contingent on the truth of a particular knowledge claim. Simply put, they were equally related to knowledge claims and justifications.

A clear example of an explanation in the Sarnecka and Carey (2008) text can be seen in the quote on the top section of Table 3, which argues that performance on the How-Many task\textsuperscript{17} is not a valid justification for the claim that a child knows the cardinal principle. Although the argument behind the explanation is only hinted at (and cited) without being described explicitly (and hence, this quote is only a part of the whole explanation), the quote in Table 3 makes for a simple example in which all relevant components—the knowledge claim, the justification, and the explanation of the relationship between them—appear in some form. As it is developed elsewhere throughout the Sarnecka and Carey text, the argument mentioned in the quote (i.e.,

\textsuperscript{17} The version of the How-Many task relevant to the current purposes (there are several versions) involves a child first counting a set of items, and then, at the conclusion of their count, being asked how many are there? Two common responses to this question are (a) repeating the last word reached when counting or (b) recounting.
The discursive functioning of knowledge claims in research studies

that the How-Many task overestimates knowledge of the cardinal principle) addresses the lack of concurrent validity between performance on the How-Many task and performance on other measures of cardinal-principle knowledge, in particular the Give-N task. The lack of concurrent validity undermines the assumption that both tasks are measures of the same knowledge. To resolve this inconsistency, the How-Many task is claimed to overestimate knowledge of the cardinal principle.
The discursive functioning of knowledge claims in research studies

Table 3. Quote with knowledge claim, justification and explanation components extracted.

<table>
<thead>
<tr>
<th>Knowledge Claim</th>
<th>Justification</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of the cardinal principle</td>
<td>[performance on] the How-Many task</td>
<td>Many children actually do repeat the last numeral used in counting without (apparently) understanding that it refers to the cardinal value of the set (Frye et al., 1989 and Fuson, 1988).</td>
</tr>
</tbody>
</table>

The upper row of Table 3 shows a quote (1989) that contains an explanation, knowledge claim, and justification. The lower rows of Table 3 show how different parts of the overall quote embody a knowledge claim, justification, and explanation.

4.2.b.ii.1 Explanations and concurrent validity. The explanations initially identified in the Sarnecka and Carey article all involved concurrent validity. This occurred in two main ways. First, as in Table 3, explanations may address a lack of concurrent validity\(^{18}\) between ostensible measures (i.e., justifications) of the same knowledge claim. This is done by arguing one of the following: (a) that one of the “justifications” in question indicates a different type of knowledge from what was originally assumed, or (b) that the earlier-achieved (i.e., the one that children are able to perform first) justification is a reflection of rote/procedural rather than conceptual knowledge, or alternately that the later-achieved justification is delayed due to task/procedural or other extraneous difficulties.

\(^{18}\) In this case, a lack of concurrent validity refers to a finding (from either a single research report, or across multiple research reports) that children perform differently on two measures of the same form of knowledge, something which would not be expected insofar as both measures are tests of the same thing.
The discursive functioning of knowledge claims in research studies

The other type of explanations were those premised on the unexpected presence of concurrent validity between various tasks, which led to explanations that performance on a given task is a justification for a knowledge claim that it was not otherwise assumed to justify. For example, in the Sarnecka and Carey text, the presence of concurrent validity between performance on the Give-N task and some other measures of counting proficiency is used as an explanation for why the former is not only a measure of the cardinal principle, but of a more general understanding of how counting works (see [5; 9-32] and appendix 3).

Explanations dealt with the unexpected presence or lack of concurrent validity across two or more ostensible justifications (J1, J2, …Jn) of the same or different knowledge claim(s) (K1, if applicable K2, etc.) in the following ways:

a. Another justification of K1, J2 (and possibly J3, J4…etc.), is achieved after J1.
   i. J1 is accomplished through some other, simpler, means (e.g., by rote)
   ii. Either J1 or J2 measures a different kind of knowledge than was assumed
   iii. J2 involves extraneous performance demands

b. Other justifications of K1 (J2, J3, …) are achieved before J1.
   i. J1 involves extraneous performance demands
   ii. J2 (and possibly J3, etc.) are accomplished through some other, simpler means (esp. by rote)
   iii. Either J1 or J2 justifies a different kind of knowledge than was assumed

c. J1, a justification of K1, has concurrent validity with other presumably valid justifications of a different type of knowledge (K2). Therefore, J1 may be treated as a justification of K2 (For example, see Appendix 3)

These varieties were distinguished through analysis of explanations in the text. They reflect explanations that were observed as well as those that, while not observed, are simple variations
The discursive functioning of knowledge claims in research studies

on those that were observed, and consequently, might be expected. An in-depth example that shows many of these explanations is shown below in Table 4. (As an additional resource, Appendix 4 shows a section of the Sarnecka and Carey (2008) text with the explanations marked in bold.)
Table 4. Explanations (and the arguments on which these are founded) concerning the validity of the How-Many or Give-N tasks as measures of the cardinal principle.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Quotes</th>
</tr>
</thead>
</table>
| 1.   | The How-many task is presented as an ostensibly valid measure of cardinal principle knowledge.  
       Note: “last word responding” or “repeating the last numeral used in counting” are forms of performance on the How-many task. | …young children do not understand the cardinal principle. That is, children do not seem to recognize that the last numeral used in counting tells the number of items in the set. One type of evidence comes from How-Many tasks. [3; 15-19]
|      | The Give-N task is presented as a measure of cardinal principle knowledge.  
       Specifically, passing the Give-N task (i.e., being a CP-Knower) is taken to indicate knowledge of the cardinal principle. | The Give-N task provides a different way of measuring cardinal-principle knowledge. [4; 9-16]  
       After the child has spent some time (often more than a year) as a subset-knower, her performance undergoes a dramatic change. Suddenly, she is able to generate the right cardinality for numerals “five” and above. But whereas she progressed through the subset-knower levels gradually (learning “one,” then “two,” then “three,”...) she seems to acquire the meanings of the higher numerals (“five” through however high she can count) all at once. We call children at this level cardinal-principle-knowers (sometimes abbreviated CP-knowers). [5; 3-8]
| 2.   | Evidence is reported showing that performance on the Give-N task and the How-Many task is not concurrent. Specifically, since subset knowers (who are not yet CP-knowers) succeeded on the How-many task, it is concluded that children succeed on the How-Many task before they succeed on the Give-N task (i.e., children succeed on the How-Many task before they are CP-knowers) | virtually all of our cardinal-principle-knowers did get both trials [of the How-Many task] correct, and so did three-quarters of the “two,” “three”- and “four”-knowers, and a quarter of the pre-numeral-knowers.  
       Clearly, many children learn a procedural ‘How-Many’ rule (i.e., that the answer to the question “how many” is the last word reached in a count) long before they understand the cardinal principle. These findings confirm earlier reports (e.g., Frye et al., 1989 and Fuson, 1988) that How-Many tasks should not be used as a measure of cardinal-principle knowledge. |
3. The concurrent validity of the Give-N task with other measures of cardinal principle knowledge implies that it is a valid measure of this knowledge.

At the same time, the lack of concurrent validity of other cardinality tasks with the How-Many task is taken to indicate that the How-Many task measures a simple procedural rule, rather than understanding of the cardinal principle.

Given that other studies have shown high within-child consistency across cardinality tasks including Give-N, the Counting Puppet task, What's-On-This-Card, etc. (Le Corre et al., 2006, Le Corre and Carey, 2007 and Wynn, 1992), it seems fair to conclude that the difference we find between How-Many scores and Give-N scores in the present study is a result of our task using the exact phrase "how many," which is enough to prompt many children to answer with the last word of a count, whether they understand the cardinal principle or not. [21-22; 39-3]

Clearly, many children learn a procedural 'how-many' rule (i.e., that the answer to the question "how many" is the last word reached in a count) long before they understand the cardinal principle. These findings confirm earlier reports (e.g., Frye et al., 1989 and Fuson, 1988) that How-Many tasks should not be used as a measure of cardinal-principle understanding, because they tend to overestimate children's knowledge of how counting works. [21; 8-19]
The discursive functioning of knowledge claims in research studies

Table 4 shows the role of explanations in Sarnecka and Carey’s consideration of the How-Many and Give-N tasks as measures of children’s understanding of cardinality. Ultimately, the Give-N task is explained to be a valid measure of cardinality knowledge, while the How-Many task is concluded to be invalid. This argument is developed in three main steps, as shown in Table 4 above. In the first step, both tasks are presented as at least ostensible measures of an understanding of cardinality. Secondly, findings are reported showing that performance on both tasks is not concurrent. This cannot be reconciled with the fact that both tasks are measures of the same knowledge. Consequently, it is argued that the Give-N task is the valid measure of the cardinal principle, while the How-Many task is not. These arguments are premised on (a) the claimed concurrent validity of the Give-N task with other measures of cardinality knowledge, and (b) the alternative explanation for children’s relatively early success on the How-Many task, namely that children passing the task may have merely learned a procedural rule, rather than a conceptual principle (i.e., the cardinal principle).

4.3 Initial Consideration of the Relationship Between Knowledge Claims, Justifications and Explanations

4.3.a The Relationship Between Knowledge Claims and Justifications

In order to develop the basic analytic categories (knowledge claim, justification, explanation) into an initial model of how knowledge claims function discursively, it is necessary to characterize the relationship between them. The most basic issue in this relationship is the connection between knowledge claims and justifications. Why does a particular statement provide valid justification for one knowledge claim rather than another? Why does a knowledge claim imply some justifications rather than others? Of course, one answer to this question is that such pairings are normative in relation to a background of certain forms of life that is shared by interlocutors for whom the pairings are
The discursive functioning of knowledge claims in research studies

Sarnecka and Carey text, a puzzle emerged for us. On one hand, there were numerous cases in which the relevance of a particular justification to a particular knowledge claim was never explained, but treated as self-evident. On the other hand, there were many cases in which, via explanations, the knowledge claim-justification connection was explicitly dealt with. As the following analysis shows, these contrasting cases are particularly informative about the functioning of knowledge claims. To begin examining this issue, we turn first knowledge claim-justification pairings that are not addressed with explanations, followed by those that are.

4.3.a.i Self-evident connections between knowledge claims and justifications. The following quote is one example of the assertion of a knowledge claim on the basis of a justification in the absence of any explanation given to account for the justification being relevant to the particular knowledge claim. Tentatively, we may say that these justifications had a self-evident or a priori relevance to the knowledge claims they were used to justify. For example, consider the following case:

...evidence that young children do not understand the cardinal principle. That is, children do not seem to recognize that the last numeral used in counting tells the number of items in the set. One type of evidence comes from How-Many tasks. The version used by Schaeffer et al. (1974) is typical:

“Each child was asked to count the chips in a line of x poker chips, where x varied between 1 and 7. After the child had counted the chips, the line was immediately covered with a piece of cardboard and the child was asked how many chips were hidden. Evidence that he knew... [the cardinal principle] was that he could respond by naming the last [numeral] he had just counted.” (p. 360) [3; 16-24]
The discursive functioning of knowledge claims in research studies

There is no explanation given for why performance on the How-Many task (the justification) is relevant to speculation about the child’s understanding of the cardinal principle (the knowledge claim), either in the quote above, or in the text surrounding it. Naming the last numeral he had just counted is brought forth, without further explanation, as a potentially valid justification for children’s knowledge of the cardinal principle. A similar lack of explanation for the relevance of a particular justification was found in many instances throughout the text, including with some of the main knowledge claims made in the article (e.g., the knowledge claims introduced on [7; 13-17 are asserted contingent on certain task performances (justifications), but the relevance of these to the knowledge claims is never addressed).

The fact that the justifications given for knowledge claims have, in some cases, an assumed or self-evident relevance is to be expected from the Wittgenstein-influenced view of language (for more on this, see Appendix 1): language use is premised on an unstated background of shared forms of life. Against such a background, certain ways of talking (such as certain ways of reaching and defending conclusions) are, for certain interlocutors, taken as normative, without any need to explain. In the case of knowledge claims, this means that a justification is related to its knowledge claim simply by virtue of how each statement is understood; one implies the other. For further explanation of this kind of normativity, see Appendix 1.

4.3.a.ii Knowledge Claim-Justification Pairs Mediated by Explanations. If knowledge claims and justifications are normatively related, what is the role of explanations, which mediate between them? If the link between a knowledge claim and its justification has to be explained (as it does when explanations are present), it might seem that this link is not a normative one (for the author and/or intended audience). However, a close reading of how explanations function shows that they are premised on the implicit or default presumption of the validity of the ultimately invalid behavior (invalidated justification). That is, they deny the validity of a particular justification (e.g., a behavioral criterion or task) when no explicit claims were ever
The discursive functioning of knowledge claims in research studies

made in support of the validity of that justification. This denial of otherwise assumed validity is illustrated by the following example:

    Many children answer the question “how many” with the last word used in counting, despite not understanding how counting works. [1; 13-14]

This quote is an implicit explanation insofar as it denies the validity of a justification (so-called “last word responses” on the How-Many task) for the claim that a child understands how counting works. Importantly, giving last word responses has not previously been introduced in the text (this quote comes from the abstract). This quote only makes sense if one presupposes that answering the question “how many” with the last word used in counting normatively implies that one understands of how counting works. This can be illustrated by reference to the way that similar quotes lacking such a presupposition do not make sense—e.g., Many children can say the word “cat” despite not understanding how counting works. Although this second statement also denies that a particular behavior is a valid justification of understanding how counting works, the fact that it makes no sense corroborates the idea that the validity of certain justifications (in relation to a particular knowledge claim) can be presupposed.

This suggests that, although explanations may be used to assert or deny the validity of a particular justification, this is only done for justification-knowledge claim pairings whose validity is presupposed. As a result, rather than suggesting that knowledge claims are not normatively linked to their justifications, the explanations provide further corroboration for this idea.

The idea that explanations are premised on normative implications between knowledge claims and justifications accounts for why they involve concurrent validity. Explanations for particular knowledge claim-justification pairings were almost always given when children were found to carry out some but not all of the behavioral performances that serve as possible

\footnote{The only exceptions to this are explanations that involve the unexpected finding of concurrent validity of a justification (J1) with the justifications (J2) for another knowledge claim (K2). In these situations, the explanation functions by explaining why J1 is a justification for K2 as well as the claim it originally justified, K1.}
The discursive functioning of knowledge claims in research studies

justifications for a knowledge claim. Such situations are inherently problematic, since the achieved justifications imply the knowledge claim while the unachieved justification(s) simultaneously contest the claim. Explanations resolve this inconsistency by redefining or recasting the inconsistent justifications in a way that eliminates their normative connection with the knowledge claim\(^2\).

This can be illustrated with the case of children’s understanding of the cardinal principle, and the use of performance on either the How-Many or Give-N tasks as justifications for this knowledge claim (i.e., understanding of the cardinal principle). Both task-performances are introduced in the Sarnecka and Carey text as self-evidently valid justifications for the knowledge claim. Subsequently, it is found that children who pass the How-Many task may fail other cardinality-related tasks like the Give-N task. This is problematic for drawing conclusions about children’s understanding of the cardinal principle insofar as performance on both tasks is normatively implicated by the cardinal principle. As far as children’s understanding of cardinality is concerned, there is no explanation for failing one but not the other task. To address this inconsistency, an explanation may be used to redefine performance on the How-Many task—i.e., redescribing this task performance as following a simple procedural rule for how to answer the question how-many, without understanding the conceptual significance of this rule—in a way that severs its normative connection with the claim that a child understands the cardinal principle.

Summing up the findings of the previous paragraphs, the explanations identified in the article involved negotiating the already-assumed normative relations between knowledge claim(s) and one or more justifications. In other words, explanations did not establish the normativity "from the ground up": they did not explain why a justification that would not (in

\(^2\) As this suggests, it is not the performances themselves, but rather their characterization that is relevant (and normatively linked) to a particular knowledge claim.
The discursive functioning of knowledge claims in research studies
general) have any\textsuperscript{22} relation to a particular knowledge claim is in fact a valid justification of that claim. Instead, they negotiated already-assumed normative connections between justifications and knowledge claims in order to resolve inconsistent and contradictory patterns of findings.

4.3.b An Alternate Role for Explanations: Type 2 Explanations

Although the explanations in the Study 1 were found to negotiate already-existing normative connections between knowledge claims and justifications, this does not mean that the establishment or negotiation of this normativity itself could never be an issue. Normative connections between a knowledge claim and a particular justification only exist as such for a particular community of interlocutors, whose activity establishes and maintains this normativity. While such normative connections may be a dependable fact of life in a particular community, they are not necessarily established beyond the context of that community. In fact, from a hypothetical perspective outside of any particular community, there is no necessary link between a knowledge claim and a justification (or any other statements for that matter). From this, it follows that the same claim may (normatively) imply different justifications in different communities. In other words, the implications (in terms of implied behavioral capacities) of a knowledge claim may be understood as contingent on the context of the claim. In terms of a concrete example the normative implications of what it means to say that a child understands how to count may be different depending on whether the claim is made by a parent or a cognitive development researcher.

This allows us to make a prediction, which can be assessed through the analysis of additional texts in the second study. If the links between knowledge claims and justifications exist only as normative links—and therefore, only within the discursive context of particular communities—then the matter of which links are normative, or whether a link is normative,

\textsuperscript{22} For example, explanations would not explain why the knowledge claim “s/he understands the concept of volume” would be justified by the fact that “s/he is able to ride a bike independently.”
The discursive functioning of knowledge claims in research studies should be related to the addressivity of the text. In other words, the matter of which knowledge claim-justification pairings are normative depends on the assumed audience for the text. What this means is that the only situation in which the linkage between a knowledge claim and justification would be explained or negotiated without the presumption of normativity already linking them would be when the audience has not been firmly established, or when it has been made ambiguous.

In recognition of the possibility of this other kind of explanation, explanations will be, from here on out, identified as either Type 1 or Type 2 (this is reflected in the Model). Type 1 explanations are those that pertain to a knowledge claim-justification pairing whose normativity is presupposed. Type 2 explanations deal with the relation between knowledge claims and justifications in cases where the normative implication between the two is not taken for granted, and needs some explication. Type 2 explanations should only be seen in cases in which a text is addressed to an assumed audience for whom a particular knowledge claim-justification pairing is not presupposed as normative, or in cases where the audience has not been clearly established, since these are the only situations in which normative implications would be ambiguous or undefined.

Although it is not central to the overall arguments of the text (and as such, is not well developed, and fairly ambiguous), one statement in the text had qualities of a Type 2 explanation, and is instructive about what these might look like. The statement in question is found at the very beginning of the text, where the authors write,

It seems uncontroversial to say that some children know how to count and others do not. But how can we tell them apart? If knowing how to count just means reciting the numeral list (i.e., “one, two, three...”) up to “five” or “ten,” perhaps pointing to one object with each numeral, then many two-year-olds count very well (Baroody and Price, 1983, Briars and Siegler, 1984, Fuson, 1988, Fuson et al., 1982, Gelman and Gallistel, 1978, ...
The discursive functioning of knowledge claims in research studies

Miller and Stigler, 1987 and Schaeffer et al., 1974). That kind of counting is good for marking time (e.g., close your eyes and count to ten...) or for playing with one’s parents, but reciting the alphabet or playing patty-cake would do just as well. The thing that makes counting different from the alphabet or patty-cake is that counting tells you the number of things in a set.

Of course, counting only tells you this if you do it correctly, following the three ‘how-to-count’ principles identified by Gelman and Gallistel (1978). These are (1) The one-to-one principle, which says that “in enumerating a set, one and only one [numeral] must be assigned to each item in the set.” (p. 90); (2) The stable-order principle, which says that “[Numerals] used in counting must be used in the same order in any one count as in any other count.” (p. 94); and (3) The cardinal principle, which says that “the [numeral] applied to the final item in the set represents the number of items in the set.” (p. 80).

The argument given for how to discern children who know how to count has some of the qualities of a Type 2 explanation. A possible justification for knowing how to count (reciting the count list) is considered and then quasi-dismissed as the authors make the argument that what is special about counting is that it can tell you the number of things in a set, and that this is contingent on correct counting. The implication of this is that what is paramount is not knowing how to count per se, but knowing how to count correctly. More than anything else, this first paragraph functions to define and justify the focus of the text, which is children’s knowledge of how counting works (rather than just how to count) and their understanding of the principles that govern correct counting. Yet the way that the issue of “knowing how to count” is considered is suggestive of how the contextualization of a discourse within a community of practice determines the specific pattern of normative implications linking particular knowledge claims and
The discursive functioning of knowledge claims in research studies

It is noteworthy that prior to implicitly dismissing “reciting the count list” as valid justification that a child knows how to count, the authors mention a particular discursive context (playing with one’s parents)—one which is clearly different from the context in which the article is likely to be read. So, over the next few sentences, as the authors implicitly deny count list recitation as a justification for knowing how to count, this can only be taken to be with regards to a different community of practice (i.e., not playing with parents), where there are different normative implications for knowing how to count.

The very fact that the context of ‘playing with parents’ was brought up may be understood as a way to account for consideration of ‘reciting the count list’ as a valid justification for knowing how to count. In the discourse in which this text belongs, this justification would hardly be taken as normative, so even the briefest consideration of it must be accompanied by an explanation. Consequently, the authors evoke the context of ‘playing with parents’. In so doing, that “foreign” context functions as a Type 2 explanation for how ‘reciting the count list’ may justify the claim that a child knows how to count.

4.4 Summary of Results of Study 1

The initial analysis of a single text led to the development of an initial model of knowledge claim functioning, through the refinement of the initial analytic categories and the elaboration of additional categories (higher level claims, explanations). Before continuing the analysis, it is useful to summarize this general model to consolidate the gains made so far in order to contextualize the focus of the subsequent analyses.

4.4.a Basic Model

The basic model of knowledge claims involves three basic components: knowledge claims, justifications, and explanations. Knowledge claims are descriptions of what a person knows, understands, grasps or realizes that take the basic form s/he knows X, with X being
The discursive functioning of knowledge claims in research studies

some known proposition, principle or description of something that the person knows how to do. The assertion of knowledge claims is typically supported by justifications, which are reasons supporting the claim. The relation between a given knowledge claim and its justification is a normative one, meaning that the justification makes the assertion of the knowledge claim conventionally appropriate, typically without further explanation. Addressivity is evident in way that speakers/writers treat certain justifications as self-evidently valid grounds for the assertion of certain knowledge claims; i.e., the lack of further explanation for why a particular justification supports a particular knowledge claim implies the speaker’s/writer’s assumption of an audience for whom such a pairing makes sense.

The third component of knowledge claims—explanations—negotiate the relationship between knowledge claim(s) and justification(s). Explanations are thought to function in two main ways. First, Type 1 explanations are used to make sense of why some knowledge claim-justification pairings that normatively implicate each other are, in fact, not valid. Secondly, Type 2 explanations may function to situate a knowledge claim-justification pairing within a particular discourse in which a normative implication exists between them.
CHAPTER 5: STUDY 2: ANALYSIS OF ADDITIONAL TEXTS

5.1 Issues and Directions for Further Analysis

5.1.a Testing and Refining the Model of Knowledge Claim Functioning

An analysis of additional texts (see Table 1 for a list of texts) was carried out in order to further test the validity of the analytic concepts, and inform the construction of the model. The second analysis was essentially a continuation of Study 1. The general approach was to assess the use of knowledge claims in the selected texts in order to determine if they could be adequately described with the existing analytic categories (knowledge claim, justification, explanation) as these were described above. Lack of fit between the uses of knowledge claims and the texts led to consideration of how to best modify the categories. All significant instances of such modifications are described in the following sections. The ultimate goal of this analysis was the achievement of a saturation point where no further changes would be required in order to assimilate additional uses of knowledge claims from the selected texts into the model.

The following sequence describes the approach to analyzing each of the texts:

1. Thoroughly read the text in order to establish familiarity with the overall focus, arguments, and conclusions.
2. Identify the knowledge claims made in the article.
3. Identify justifications made for these knowledge claims.
4. Identify any explanations that pertain to the link between the knowledge claim and its justification.
   a. Are the explanations Type 1 or Type 2? Does it require the delineation of a new subcategory (e.g., Type 1b) or a new category (e.g., Type 3)?
      i. If Type 2, is the explanation given in a context where multiple audiences are invoked, or where multiple communities of practices are being mentioned? How and why is this done? What is the result of the
The discursive functioning of knowledge claims in research studies

explanation, and what purpose does it serve in the text? If the intended addressees are not made ambiguous, are there other aspects of the text that may be taken to account for an undefined audience?

5. Are there any claims about knowledge that do not fit the basic schema of knowledge claims supported by justification? Are these similar to other higher order knowledge claims in that they involve conclusions resulting from the overlapping implications of multiple knowledge claims, and/or objectify knowledge that is rooted in the standard model of knowledge claims? If not, how are these claims constructed?

6. Are there overall addressivity-related differences in what is assumed-to-be understood, versus what is made explicit, vis a vis knowledge claims, across texts? (For any results and consideration of this issue, see Appendix 2. Note that Appendix 2 is written as a continuation of the final conclusions of the current research, rather than the tentative conclusions reached up to this point.)

7. Based on the overall results of the analysis, how do knowledge claims appear to function (in general) and what purposes do they appear to serve?

5.2 Results of Study 2

Statements exemplifying the categories of knowledge claim, justification and explanation were identified in each of the subsequently analyzed texts,\textsuperscript{23} and thus, these overall categories were retained. Nevertheless, the findings necessitated various changes, including the addition/merging of categories and the refinement of other criteria. These changes are described in the following sections. The first sections deal with explanations, and the delineation of new subcategories of these. Within these first sections, there is also a description of a new

\textsuperscript{23} While the non-discrete nature of statements embodying these categories prevents exact frequency counts, relatively discrete instances of knowledge claims and justifications tended to be found at least once per paragraph, with explanations found once every few paragraphs. The exception to this was the method sections (and to a lesser extent, results sections), where demarcation of discrete justifications/explanations was not possible.
The discursive functioning of knowledge claims in research studies

process—*redescription*—which was identified as a way that writers negotiate the connections between knowledge claims, justifications and observed behavioral performances. After the findings relating to explanations, a number of specific examples of knowledge claims and justifications are described which raise questions about the distinction between knowledge claims and justifications. Based on these results, and the various changes made to the model to accommodate them, it is possible to rethink some of the fundamental categories in the model.

5.3 Revisions to Explanation Categories and New Types of Explanations

The analysis of subsequent texts continued to confirm the idea (from Study 1) that explanations (statements that address, account for, or otherwise negotiate the link between a knowledge claim and its justification) can take one of these two forms:

1. Explanations that are premised on the assumed normativity (for the intended audience) of the claim-justification pairing, and address a possible or observed presence/lack of concurrent validity between one or more normative justifications for a given knowledge claim.
2. Explanations that seek to establish the normativity of a claim-justification pairing.

Although these overall categories were maintained, new findings led them to be developed in several ways, both differentiating existing categories into new categories (1a/b and 2a/b) and amending some existing categories. These changes are discussed in the following sections.

5.3.a Type 1 Explanations

5.3.a.i Differentiation of explanation Type 1 into Types 1a and 1b. The original category of Type 1 explanations encompassed primarily (but not exclusively24) explanations that were premised on the presumption of a particular claim-justification pairing being normative, and were used to account for the presence or absence of concurrent validity between particular

24 The only exception were Type 1 explanations that involved the *presence* of concurrent validity, e.g., Sarnecka and Carey (2008) [5; 9-32].
The discursive functioning of knowledge claims in research studies

knowledge claim(s) and justification(s). The analysis of subsequent texts revealed a new type of explanation that fit within the Type 1 grouping insofar as it is premised on the assumed understanding of the normativity of the knowledge claim-justification relation. However, unlike existing Type 1 explanations, these explanations—from here on referred to as Type 1b, as opposed to the original Type 1a explanations—do not address a lack of concurrent validity. Instead, Type 1b explanations involve the argument that a given justification is not normatively implied by any other reasonably asserted knowledge claim, besides the claim it is being used to justify, and that therefore, the justification must constitute proof of the knowledge claim in question. In a typical case in which the justification is performance on a particular task, Type 1b explanations argue that performance on the task must imply a particular bit of knowledge because no alternative forms of knowledge could conceivably account for the observed task-performance. As an example of a Type 1b explanation, consider the following:

The invention and correct use of idiosyncratic lists is hard to explain unless appeal is made to some implicit rules that guide the children's search of their environment for a list with which to count. This argument is the same one used to account for overgeneralization errors, e.g., runned, unthirsty, in a child's speech. The occurrence of such novel but lawful count sequences makes it necessary to postulate an implicit set of rules. (Gelman & Meck, 1983) [3; 5-10]

In considering Type 1b explanations, it's important to note that any given justification cannot, in principle, imply only a single knowledge claim. Justifications are descriptions of behavior or behavioral dispositions, and any performance can, in principle, be learned and carried out by rote, in which case the justification would imply a knowledge claim of "rote/procedural knowledge." However, at least with respect to the counting/number use activities that are relevant to the current research, rote performance ability can never be the only possible reason
The discursive functioning of knowledge claims in research studies

for a performance. There are always multiple possible reasons or interpretations for the same overt behavior.

This point is argued by Wittgenstein, who claims that the ability to continue a sequence that embodies a pattern does not imply knowledge of any particular rule that the pattern illustrates, since any finite sequence of events is consistent with an infinite number of patterns. For instance, a child who is asked to recite the even numbers, and does so to 100 does not necessarily know the rule for counting by even numbers. This child might count by even numbers to 100, and assume the rule is to continue on from there in a different way (Taylor, 1977; Wittgenstein, 1953, § 185).

Type 1b explanations are intriguing in that they treat these alternative possibilities as impossibilities. They claim that a particular knowledge claim implied by a justification is the only one that can be expected to be true, without explaining why this is the case (beyond saying that there ‘can be no other explanation’). By claiming that a given justification is proof of a given knowledge claim because there can be no other explanation, Type 1b explanations imply the speaker/writer’s presumption of certain limits on what types of knowledge a person can be claimed to have.

5.3.a.ii Reassessment of concurrent validity in Type 1 explanations. The analysis of subsequent texts also raised questions about Type 1a explanations; i.e., those that involve concurrent validity between justifications. In several of the texts, statements resembling Type 1a explanations were given in cases where concurrent validity was not mentioned. These statements resembled Type 1a explanations in focusing on how performance factors could interfere with a child’s performance on a task. Such arguments are generally seen in Type 1a explanations where they explain the problematic lack of concurrent validity. This is evident in the following quote from Gelman and Meck (1983), which is an explanation regarding the use of error detection tasks to provide justification that children have knowledge of the cardinal principles.
The discursive functioning of knowledge claims in research studies

In the error detection experiments children watched a puppet count and told the experimenter whether the puppet was right or wrong. Thus children did not have to generate the counting performance, they only monitored it for conformance to the principles. When the child does the counting herself, she must both generate and monitor the performance. Hence, an error detection task should be easier than a standard counting task. [3; 36-41]

The preceding quote functions to explain why the error detection tasks are a sensitive measure of children’s knowledge of the counting principles. While this explanation is not explicitly a reaction to an observed lack of concurrent validity, a lack of concurrent validity is implied: the possibility that a child might differentiate correct counts carried out by a puppet, but that they might be too burdened to do this when they have to count themselves means that they would succeed at one task before the other, even though both ostensibly measure the same knowledge. Consequently, an explanation for the validity of an error detection task is given based on an anticipated, but not observed, lack of concurrent validity with another task.

5.3.a.iii Redescription as a feature of Type 1a explanations. Type 1a explanations were found to share an additional common feature. This feature, redescription, refers to the technique of recharacterizing a knowledge claim or justification in meaningfully different terms. This is commonly seen in Type 1a explanations in which it is argued (or considered) that a given performance was incorrectly characterized, and might be better characterized in different terms. For instance, consider the following example from Sophian (1988), where it is argued that what was previously described as children’s failure to make inferences about numerosities might be better described (redescribed) as children who could have otherwise made inferences failing to do so because of processing demands/the suspicion that the experimenter was trying to trick them.
The discursive functioning of knowledge claims in research studies

Children’s performance [in making inferences about the numerosities of sets] also might have been impaired by the reliance on verbal statements by the experimenter to convey crucial information about the numerosities of the set(s) and/or the correspondence between them. Children could always see some elements of both of the sets involved in a problem, but one set was always piled together in the bottom of the cup so that children could not see for themselves how many objects were in that set or how they corresponded to the elements of the other set. Children who thought the experimenter might be trying to trick them, and those who simply had trouble processing the experimenter’s verbal statements without perceptual support, may have failed to make inferences under these circumstances that they could have made if they had had the opportunity to see the numerosities or correspondences for themselves. [7L; 21-40]

Redescription can happen in different ways as well, although these cases still involve Type 1a explanations. Rather than redescribing a justification (e.g., redescribing the performance on a task), the original justification might be preserved, but argued to be the basis for an alternative knowledge claim. While these cases might be given their own label (e.g., reassignment), they are only trivially different from redescribing performances themselves, and will be referred to using the same label.

One case of this type of redescription constituted one of the most common examples in the analyzed texts: redescription of the meaning of children’s last word responses. While researchers once took last-word responses as indicating knowledge of the cardinal principle, their significance is redescribed in several of the analyzed texts. This is seen in the following quote:

More important, Fuson (Fuson & Hall, 1983; Fuson, Pergament, Lyons, & Hall, 1985) raises the possibility that the first cardinality responses could follow a principle more
The discursive functioning of knowledge claims in research studies

primitive than the one Gelman has put forward [i.e., the cardinal principle]. Children may initially answer the "How many?" cardinality question by using a last-word strategy. They may know, perhaps as a part of a conventionalized social game, to give the last counting number they reach in response to the usual "How many?" question without realizing that the number represents the cardinality (total) of the set. (Frye et al., 1989) [5L; 46-56]

Breaking the quote apart for analysis, we can specify the knowledge claims made on the basis of children’s so-called “last word responses,” both prior to redescription, and after redescription. These are shown on the first example in Table 5 (below), which contains, from left to right, the original quote, the pre-redescription knowledge claim, the post-redescription knowledge claim, and background information that describes the context of each quote. Table 5 also shows two other examples of redescription, listed in the rows below the first example.
Table 5. Examples of re-described knowledge claims from the analyzed texts (chart continues onto next page)

<table>
<thead>
<tr>
<th>Quote</th>
<th>Before redescription</th>
<th>After redescription</th>
<th>Background Info.</th>
</tr>
</thead>
<tbody>
<tr>
<td>More important, Fuson (Fuson &amp; Hall, 1983; Fuson, Pergament, Lyons, &amp; Hall, 1985) raises the possibility that the first cardinality responses could follow a principle more primitive than the one Gelman has put forward [i.e., the cardinal principle]. Children may initially answer the &quot;How many?&quot; cardinality question by using a last-word strategy. They may know, perhaps as a part of a conventionalized social game, to give the last counting number they reach in response to the usual &quot;How many?&quot; question without realizing that the number represents the cardinality (total) of the set. (Frye et al., 1989) [5L; 46-56]</td>
<td>realizing that the number represents the cardinality (total) of the set, i.e., the cardinal principle</td>
<td>Knowing, perhaps as a part of a conventionalized social game, to give the last counting number they reach in response to the usual &quot;How many?&quot; question without realizing that the number represents the cardinality (total) of the set.</td>
<td>This quote concerns children’s responses to the question <em>How many are there?</em>, asked about a set of items they’ve just counted. <em>Cardinality responses</em> refer to children responding to the question with the number they reached in a previous count of the item.</td>
</tr>
<tr>
<td>Other investigators have argued against the view that very young children know these principles. Illustratively, Sophian and Huber (in press) contended that 3-year-olds do not know the causal principle of priority. They argued that 3-year-olds’ successful performance is based on associations between familiar actions and their consequences. (Briars and Siegler, 1984) [2; 43-45]</td>
<td>knowing the causal principle of priority</td>
<td>[the ability to act] based on associations between familiar actions and their consequences.</td>
<td>This quote discusses previous debates about whether children know certain conceptual principles before or after the age of 3-years.</td>
</tr>
<tr>
<td>Gelman and Gallistel (1978) ... inferred that preschoolers know [the counting] principles largely on the basis of observations of preschoolers counting sets of objects. This use of the standard counting situation ... may not have been optimal for distinguishing between whether children knew counting principles or whether their knowledge was limited to an ability to execute standard counting procedures. (Briars &amp; Siegler, 1984) [1-2; 41-8]</td>
<td>knowing the counting principles</td>
<td>an ability to execute standard counting procedures</td>
<td>This quote is a part of a larger discussion of children’s understanding of the principles that underlie different aspects of correct counting.</td>
</tr>
</tbody>
</table>
When 3-year-olds saw a set labeled with a number (e.g., *five*) and an item was added, they preferred a new label (*six*) over the old one, as though they believed that number words have precise meanings. … (Brooks, Audet & Barner, 2012) [2; 7-9]

In Experiment 2, children were tested using similar methods, but with novel nouns and objects that were transformed, instead of sets. Children showed the identical pattern of results despite lacking meanings for these words, suggesting that their judgments for numerals may not have relied on semantic knowledge that numerals have precise meanings. We propose that children’s behavior can be explained by the use of domain-general pragmatic inference, and does not require positing domain-specific numerical knowledge. … children can exploit the pragmatics of contrast. After hearing one label used to refer to a set, and seeing the set transformed, children are then presented with a second numeral which is directly contrasted with the original one, an invitation to consider it as the label for the new set.” (Brooks, Audet & Barner, 2012) [22; 4-10]

| This quote pertains to the question of whether preschool-age children understand that number words refer to precise and/or specific quantities. | they believed that number words have precise meanings | their judgments for numerals may not have relied on semantic knowledge that numerals have precise meanings… children’s behavior can be explained by the use of domain-general pragmatic inference, and does not require positing domain-specific numerical knowledge. … children can exploit the pragmatics of contrast. After hearing one label used to refer to a set, and seeing the set transformed, children are then presented with a second numeral which is directly contrasted with the original one, an invitation to consider it as the label for the new set. | The discursive functioning of knowledge claims in research studies |
The discursive functioning of knowledge claims in research studies

As the first three examples in Table 5 show, researchers may address the principles/skills first issue (i.e., procedural versus conceptual knowledge) by redescribing the child’s behavior to make it consistent with a different knowledge claim. If this can be done for all justifications asserted as evidence for a particular generalized knowledge claim, it may be concluded that children lack that knowledge, even though they have achieved what had been considered to be its justifications. Conversely, if it has been argued that a child lacks knowledge on the basis of failures in performances that would serve to justify that knowledge, this conclusion can be contested by redescribing the failures in terms of performance issues. For examples of both types, see Frye et al., (1989) [2; 49-16] and [2L; 30-47].

The final example in Table 5, from the Brooks, Audet and Barner (2012) text, shows an example of a knowledge claim about conceptual knowledge of number being redescribed in terms of a knowledge claim of pragmatic knowledge. Although nominally different from the redescriptions in terms of procedural/conceptual knowledge, the conclusions are reached in essentially the same way.

5.3.b Type 2 Explanations

5.3.b.i Differentiation of explanation Type 2 into Types 2a and 2b. The analysis of explanations in Study 1 led to the identification of Type 2 explanations—explanations that are not premised on the assumed (by the addressed audience) normativity of a claim-justification relation, but rather establish that normativity. Based on the subsequent analysis, the initial category of Type 2 explanations was differentiated into two subcategories.

5.3.b.ii Type 2a Explanations. Type 2a explanations attempt to establish the normativity of a knowledge claim-justification pairing through explicit reference to a community (form of life) within which such a pairing would be normative. In essence, these explanations
The discursive functioning of knowledge claims in research studies

acknowledge that a given task-performance or knowledge claim may implicate different things in different communities, but that within the present text, a particular community’s implication is taken up. Type 2a explanations have been observed only rarely; in fact the text analysis has revealed only two examples of them, both of which only show partial Type 2a qualities (both feign the act of questioning the intended audience for rhetorical purposes, rather than out of real confusion about who the audience is). The first case was previously discussed above (Chapter 4, section 3b), and came from the Sarnecka and Carey (2008) article. The second, quoted below, is from Sarnecka and Wright (2013):

What does it mean to say that a child understands numbers? There are many early milestones in number learning, and parents sometimes say that a toddler who can count to five or ten ‘knows’ those numbers. Similarly, young children in literate environments learn to identify the written digits 0–9 along with letters of the alphabet and thus, in a sense, ‘know’ the numbers. But what does it mean to understand numbers, in some important conceptual way? [1; 28-32]

This quote exhibits a Type 2a explanation insofar as it presents two justifications for “understanding numbers” (i.e., “[counting] to five or ten”, and “learning to identify the written digits 0-9”). These are then discarded, not on the basis of some lack of validity, but rather by the suggestion that these reflect different normative uses of the knowledge claim understanding number. This suggestion is implicit in the identification of these justifications with other discursive communities: parents talking about their children, and unspecified “literate environments” (possibly a school classroom).

This explanation also shows some qualities of a Type 1a explanation. Specifically, the “discarding” of the two possible justifications is accomplished, in part, by redescribing the knowledge claim itself, through the addition of “understanding numbers, in some important
The discursive functioning of knowledge claims in research studies

concep
tual way” (emphasis added). Secondly, to some extent, the non-normativity of the justifications for “understanding number” is assumed as understood, as reflected by the use of quotes around the words *know* and *understand*.

Despite the presence of these Type 1a qualities, they do not fully dominate the explanation, and the discarding of the considered justifications is accomplished at least as much by the respecification of the knowledge claim as by the identification of those justifications with discursive contexts that are clearly distinct from the likely audience of a research text.

5.3.b.iii Type 2b explanations. The subsequent analysis of additional texts revealed a number of explanations that qualified as Type 2 explanations insofar as they did not proceed from a presumption of certain knowledge claim-justification pairings as normative for the audience. These explanations revealed the author’s assumption that a particular claim-justification pairing would *not* be normative for the audience, as evidenced by the explicit provision of reasons in support of the validity of the pairing: reasons that did not presume the validity of the pairing from the outset (as is the case in Type 1 explanations) or involve concurrent validity. However, unlike Type 2a explanations, these *Type 2b explanations* did not justify/contest a particular pairing by enacting the interpretive context of a particular community. Instead, Type 2b explanations constructed the normativity of a claim-justification pairing through additional specification of the claim or justification itself, in ways that were intended to make their pairing normative; i.e., self-evidently appropriate for the addressed audience.

Table 6 shows examples of type 2b explanations. In the first example (first row of the table), Nikoloska (2009) describes Wynn’s (1990) give-a-number task, and explains why it measures understanding of the cardinal principle. The addition of the third and fourth sentences of the quote (see left column of Table 6) is what qualifies this as a Type 2b explanation. Rather than treating the brief description of the give-a-number task as a self-evident justification for the claim that children understand the cardinal principle/counting (these are treated as
The discursive functioning of knowledge claims in research studies

interchangeable), two sentences are added to make this connection explicit, implying an assumed audience for whom this connection would not have been otherwise apparent.
Table 6. *Examples of Type 2b explanations.* The left column of the table lists a quote that encompasses the explanation and some reference to the knowledge claim(s) and justification(s) that the explanation pertains to. The second (from left) column lists the knowledge claim; the third lists the justification, and the fourth lists the explanation.

<table>
<thead>
<tr>
<th>Quote</th>
<th>Knowledge Claim</th>
<th>Justification</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wynn (1990) used the give-a-number-task to probe preschoolers’</td>
<td>understanding of counting/the cardinal principle</td>
<td>give-a-number-task ... i.e., asked the children to give a particular number of</td>
<td>The reasoning is that this is a true task which measures understanding of the cardinal principle, because children will have to count in order to determine the number asked for. If they did count it would mean that they understand the cardinality principle – with the help of counting they can determine the number asked for.</td>
</tr>
<tr>
<td>understanding of counting/the cardinal principle</td>
<td>give-a-number-task ... i.e., asked the children to give a particular number of toys (give-a-number task), and looked whether they counted to give the number asked for. (Nikoloska, 2009) [4; 25-31]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This inference task taps a key aspect of one-to-one correspondence knowledge ... A finding that pre-school children perform well on this task would support the view that these children already have considerable knowledge about one-to-one correspondence, whereas a finding of poor performance would suggest that that knowledge either has not yet been acquired or is not accessible (Sophian, 1988) [2; 15-29]</td>
<td>One-to-one correspondence knowledge (whether it is acquired and/or accessible)</td>
<td>Performance on the inference task</td>
<td>A finding that pre-school children perform well on this task would support the view that these children already have considerable knowledge about one-to-one correspondence, whereas a finding of poor performance would suggest that that knowledge either has not yet been acquired or is not accessible (Sophian, 1988) [2; 15-29]</td>
</tr>
<tr>
<td>Children's success with these inferences appears to implicate more knowledge about one-to-one correspondence than previous investigators have attributed to preschool children. Piaget (1952) claimed that at this age children's knowledge about one-to-one correspondence is limited to the ability to perceive pairings between perceptually aligned sets. This conclusion is incompatible with preschoolers' success in this study because the two sets were never simultaneously visible and so children could not have based their judgments on perceptual comparisons between them. Gelman (1982) credits preschoolers with considerably more knowledge about one-to-one correspondence that is not limited to the ability to perceive pairings between perceptually aligned sets, and not merely ... [Piaget's] conclusion is incompatible with preschoolers' success in this study because the two sets were never simultaneously visible and so children could not have based their judgments on perceptual comparisons between them. ... [Gelman's] conclusion does not appear to fit with children's successful performance in this study because children did not carry out any relevant actions with the elements of the two sets before making their judgments.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of 1-1 correspondence that is not limited to the ability to perceive pairings between perceptually aligned sets, and not merely</td>
<td>Success on inference tasks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Again, that conclusion does not appear to fit with children's successful performance in this study because children did not carry out any actions with the elements of the two sets before making their judgments. (Sophian, 1988)
The discursive functioning of knowledge claims in research studies

Type 2b explanations, as exemplified by the quotes in Table 6, function to explain why a knowledge claim is normatively linked with a justification. This involves describing or explaining relevant aspects of the justification, knowledge claim, or both. In all cases, this serves to make a connection between these elements appear normative for an audience that is assumed will need this clarification. To qualify as a 2b explanation this additional specification must be explicitly framed as a reason why a claim and justification are related (i.e., explicit reasons why a justification supports a claim, or why a claim implies a certain justification). Specification by itself, e.g., providing methodological details, doesn't constitute a Type 2b explanation, but rather a part of the justification itself.

5.3.b.iv Type 2b explanations and addressivity. Type 2b explanations are important indicators of addressivity, since they imply a lack of understanding on the behalf of the assumed audience. However, these explanations are not unique indicators of addressivity, since an assumed lack of audience understanding (on behalf of the writer) is implied by any type of clarification or specification of details. Therefore, cases in which an audience is not assumed to have pre-existing familiarity with certain knowledge claims or justifications do not necessarily lead to Type 2b explanations. The extent to which the audience is assumed to understand something is generally indicated by the overall extent to which that thing is described, regardless of whether this description takes the form of a Type 2b explanation or not. The presence or absence of such explanations may be a trivial stylistic matter. One author may describe a justification in minimal terms, and then explain why it is a valid justification (this would constitute at Type 2b explanation). Another author may simply describe the justification more comprehensively from the start. Although one approach constitutes a Type 2b explanation, both involve the same assumptions about the assumed audience’s understanding.

Finally, the presence of a Type 2b explanation does not indicate an utterance that is not premised on unstated, assumed-to-be-shared assumptions. Rather, it just indicates a particular boundary between what was assumed to be understood versus what has to be made explicit.
The discursive functioning of knowledge claims in research studies

Such boundaries exist in any case of language use. Their absence would indicate either the complete presence or absence of intersubjectivity, cases in which it would be unnecessary or impossible, respectively, to say anything. The model of knowledge claim functioning that is the final outcome of the present research conceptualizes this boundary and provides a way to locate it in any particular knowledge discourse (for more on addressivity, see Appendix 2).

Type 2b explanations closely resembled Type 1a and 1b explanations, and in fact, the latter could almost be considered a subset of Type 2b. (Insofar as the explanation is brought in to substantiate the knowledge claim-justification pairing, this implies the author’s assumption that this pairing is not normative for the intended audience.) However, for the purposes of clearly categorizing the distinct features of type 1a and 1b explanations, they are being kept separate. The key to the distinction between Types 1 and Type 2b explanations is that the former are focused, first and foremost, on the presence or lack of concurrent validity.

5.3.c Implication of New Explanation Categories for the Model

Based on the results of the text analysis, the category of explanations has been subdivided into four subcategories (Types 1a, 1b, 2a and 2b). These new categories expand the model of knowledge claim functioning developed in Study 1, but do not fundamentally challenge its underlying assumptions. While explanations were important in the initial analysis, they play less of a role in the remainder of the current research. Explanations will be revisited in the conclusion of this paper, when the final model of knowledge claims is articulated. In Chapter 7, section 3a, the extent to which these explanation categories can be reliably applied to the sampled texts is reported.

5.4 Revision of Knowledge Claim-Justification Distinction

5.4.a Lack of a Clear Boundary Between Knowledge Claims and Justifications
The discursive functioning of knowledge claims in research studies

The most important findings of the second analysis involve the distinction (or lack thereof) between knowledge claims and justifications. Knowledge claims tended to differ from their supporting justifications in certain ways. For one thing, certain verbs (*knowing* or *understanding*) were used more often for knowledge claims, while others were used more often for justifications (e.g., more concrete descriptors of actions). However, across all of the texts, the types of statements typically used for knowledge claims were found, in some circumstances, to be used for justifications, and vice versa. In some cases, the same claim functioned as both a knowledge claim and a justification, with respect to another justification and knowledge claim, respectively. The following sections describe these and other findings, which blur the boundaries between the categories of *knowledge claim* and *justification*, and ultimately lead to a reworking of this distinction.

5.4.a.i Overlap in the range of statements used as knowledge claims and justifications. One piece of evidence that brought the distinction between knowledge claims and justifications into question is the fact that the range of statements that exemplify either category blend into each other; there is no clear demarcation point between the types of statements used as knowledge claims and the types used as justifications. This is shown in the series of knowledge claims and justifications from the Frye et al. (1989) and Gelman (1972) texts shown in Table 7.

The juxtaposition of the statements in Table 7 (below) reveals a wide variation from concrete descriptions of behavior to descriptions of increasingly general conceptual knowledge. While the former are more typical of justifications and the latter of knowledge claims, it is not clear where a demarcation between the two kinds of statements could be drawn. One solution—drawing it between statements depending on whether they use verbs like *know, understand*—is not viable since many statements that functioned as knowledge claims didn’t use these verbs, and some statements that functioned as justifications did (examples of each are described in the following section).
The discursive functioning of knowledge claims in research studies

Table 7. Examples of knowledge claims/justifications.

<table>
<thead>
<tr>
<th>Examples of Knowledge Claims and Justifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fifteen addition and only four displacement Ss were surprised by the changes [in the sets, i.e., either the addition of an item, or the displacement of items.] (Gelman, 1972, p. 86)</td>
</tr>
<tr>
<td>detected counting errors caused by violations in the stable order of count words and one-one correspondence between count words and objects (Frye et al., 1989, p. 1168)</td>
</tr>
<tr>
<td>Seventy-seven percent of the children who noticed the transformations treated addition [as if it] reversed subtraction or treated elongation [as if it] reversed shortening (or vice versa) (Gelman, 1972, p. 84)</td>
</tr>
<tr>
<td>judging the standard correct counting procedure—pointing to each object in turn from left to right—as being correct (Frye et al., 1989, p. 1168)</td>
</tr>
<tr>
<td>Participants consistently treated the order irrelevant procedure—counting starting from the middle or starting with every other one—as incorrect (Frye, et al., 1989, p. 1168)</td>
</tr>
<tr>
<td>accepted order as being irrelevant for correct counting (Frye et al., 1989, p. 1169)</td>
</tr>
<tr>
<td>recognized correct counting procedures (Frye et al., 1989, p. 1168)</td>
</tr>
<tr>
<td>knew that numbers (at least small ones) [are] invariant. (Gelman, 1972, p. 84)</td>
</tr>
<tr>
<td>children knew that subtraction [was] an operation that was relevant and displacement as one that was irrelevant to number (Gelman, 1972, p. 84)</td>
</tr>
<tr>
<td>understanding that if nothing about the array changes, then the puppet’s response should not change either. (Frye et al., 1989, p. 1168)</td>
</tr>
<tr>
<td>children’s invariance schemes contain rules for reversing operations (Gelman, 1972, p. 84)</td>
</tr>
<tr>
<td>That knowledge [that the cardinal value reached on the second trick trial ought to be the same as on the first correct trial] (Frye et al., 1989, p. 1168)</td>
</tr>
<tr>
<td>[knowledge of the] stable order one-one, and order irrelevant principles (various texts)</td>
</tr>
<tr>
<td>[children’s understanding of] cardinality (various texts)</td>
</tr>
</tbody>
</table>

The examples in Table 7 show the lack of a clear dividing point between descriptions of behavior (more typical of justifications) and descriptions of conceptual knowledge (typical of knowledge claims). Moving down the table, the statements become increasingly abstracted from the concrete processes of specific forms of behavior. Descriptions of specific forms of behavior
The discursive functioning of knowledge claims in research studies

transition to more generalized descriptions of behavioral dispositions that could apply to multiple
different situations. With additional abstraction, the statements come to encompass such a
diversity of situations that the concrete features of specific forms of behavior disappear all
together.

Given the lack of a clear boundary between the types of statements used for knowledge
claims and justifications in Table 7, it is not surprising that, in some cases in the texts, the same
types of statements were found in both categories. One example of this is seen in the quote
below from Frye et al. (1989) in which a description of what a child knows (underlined) is given
as a possible justification of another knowledge claim.

That knowledge … that the cardinal value reached on the second trick trial ought to be
the same as on the first correct trial … could be evidence of [an understanding of]
cardinality, or of a less specific understanding that if nothing about the array changes,
then the puppet’s response should not change either. [11r; 24-28]

In the above quote, the finding that children know the cardinal value reached is the same as the
first correct trial—a statement typical of a knowledge claim—is considered as a justification for
the claim that they understand cardinality, or that they understand that if nothing about the array
changes, then the puppet’s response should not change either.

There are many other examples of the unclear boundary between knowledge claims and
justifications. A particularly notable example is seen in Example 1 (below), which is a quote from
Gelman (1972):

Example 1:

Together, the reactions to Phase III indicate the children treated subtraction as an
operation that was relevant and displacement as one that was irrelevant to number. This
indicates they had the ability to treat number (at least small ones) as invariant. Lending
support to this general conclusion is the evidence that the children’s invariance schemes
contain rules for reversing operations. Seventy-seven percent of the children who
The discursive functioning of knowledge claims in research studies noticed the transformations behaved as if they knew that addition reversed subtraction or that elongation reversed shortening (or vice versa).

... Reactions to the surreptitious changes introduced in Phase III indicate that Ss treated addition as relevant and displacement as irrelevant to number. ... The means of 1.5 and 0.3 reflect the fact that 15 addition and only four displacement Ss were surprised by the changes. All addition Ss noted the change as opposed to only six displacement Ss. [11-13; 30-28]

In this quote, the statement *children treated subtraction as an operation that was relevant and displacement as one that was irrelevant* functions as both a knowledge claim and a justification. It is used as a justification for the claim that *children had the ability to treat number as invariant*. It functions as a knowledge claim that is justified by the final two sentences of the quote.

Many other similar examples were found, which are altogether suggestive of problems with the distinction between knowledge claims and justifications. In addition to the blurring of knowledge claims and justifications, there was also a lack of a clear demarcation (functionally speaking) between knowledge claims describing procedural versus conceptual knowledge. This is described in greater depth in Appendix 5, which describe how both types of knowledge claims are asserted, justified and contested in essentially similar ways.

5.4.b Implications of the Interchangeability and Similarity of Knowledge Claims and Justifications

The fact that that statements that exemplified knowledge claims and justifications showed similar properties could be taken to mean that the distinction between them is a relative one, and that both are syntactically and semantically the same type of statement. To say that a statement is a knowledge claim or a justification might merely describe its function relative to
The discursive functioning of knowledge claims in research studies

another statement in a text; it may not describe a fundamental difference in the intensional meanings of the statements themselves.

Going further, one possibility that is consistent with the results and analysis so far is that both knowledge claims and justifications are descriptions of behavioral dispositions, articulated in response to situations that are presumed to allow general interpretations of observed behavior. A description of a behavioral disposition is a description of a situational capacity to perform a range of behavioral forms in flexible ways that fits a particular description. An example of a capacity description would be the claim that someone can shuck an oyster. This statement describes a capacity insofar as it doesn’t imply a single, accidental, unrepeateable act, but instead the tendency for a roughly bounded variety of related actions; i.e., a person who can shuck oysters in general could shuck that oyster, or another (slightly different) oyster, etc.

Knowledge claims function in essentially the same way as the above capacity description. If we say that someone knows how to count, we are implying that the person could adequately count in some variety of situations in which doing so would be considered to be normative.

Descriptions of behavioral capacities can be more or less general. The capacity to be able to count when one is calm and focused is more specific than the capacity to be able to count (in general). There is no apparent limit on how general knowledge claims could be. This is important because it provides a way to account for how knowledge claims that do not appear to be descriptions of behavioral capacities may be just that. These capacities are so abstract or generalized, and consequently, they are instantiated by such different forms of behavior that they cease look like a description of behavior at all.

The proposal that knowledge claims/justifications are descriptions of capacities is consistent with a variety of findings from the text analysis. These are brought together in the list below to form an argument as to why knowledge claims (and justifications) are both descriptions of capacities:
The discursive functioning of knowledge claims in research studies

1. **Knowledge claims and justifications show significant overlap in form and meaning:** Apart from their intrinsic differences, knowledge claims and justifications function in similar ways. The same statement could, and in some cases does, serve both roles with respect to another knowledge claim or justification. There is no clear cutoff between statements that function as knowledge claims and those that function as justifications. Furthermore, as the quote from Gelman (1972) seen in Example 1 showed, the same statement might perform both roles in the same text.

2. **Justifications are often descriptions of behavioral capacities:** Statements functioning as justifications (and occasionally knowledge claims) are typically descriptions of behavioral capacities. It is not clear what knowledge claims and justifications that are not descriptions of behavioral capacities are, or could be descriptions of.

3. **Therefore, knowledge claims and justifications are descriptions of behavioral capacities:** Based on the lack of a clear distinction in the phrasing and discursive functioning of knowledge claims and justifications, and the fact that many of the latter are descriptions of capacities, it is reasonable to argue that both types of statements are descriptions of capacities, albeit at widely varying levels of generality.

The preceding argument is corroborated by a number of other findings, as the following sections explain. Before describing the relevant findings, it is first necessary to mention another detail about knowledge claims and justifications, understood as descriptions of behavioral capacities. Knowledge claims and justifications are made on the basis of observations of

---

25 That is, knowledge claims were asserted contingent on justifications; justifications were the grounds for asserting knowledge claims.

26 Because knowledge claims and justifications are both considered to be descriptions of capacities, and because a justification may also function as a knowledge claim, the labels knowledge claim, behavioral capacity and capacity description should be taken to cover justifications as well. The term justification will be used, from here on out, only to refer to capacity descriptions as these function as justifications.
The discursive functioning of knowledge claims in research studies

behavior in situations that are presumed (by the speaker of the claim, acting in consideration of their intended audience) to make the observed behavior amenable to general interpretation. The design of these situations, e.g., a standardized experimental task, facilitates the interpretation of the elicited behavior in various ways. For example, the available possibilities for environmental (especially social) interaction may be limited so as to preclude certain outside influences that would afford other interpretive possibilities, e.g., suggestions that are viewed as allowing a child to perform a behavior “by rote.” It is only by virtue of constrained situations that are presumed to facilitate the interpretation of behavior that knowledge claims may be made; without these constraints general interpretation is impossible, because the conditions of emergence of the observed behavior cannot be known. Since the origins of knowledge claims/justifications in situations presumed to facilitate the interpretation of behavior is a universal characteristic of these statements as disposition descriptions, this will be treated as implicit in the following discussion and analysis of the current study.

5.4.b.1 Explaining the Normative Pairing Between Claims and Justifications. The theory that knowledge claims are descriptions of capacities provides a compelling explanation for why a particular knowledge claim would be connected to a particular justification, and why this connection often needs no explanation: If a knowledge claim is a description of a behavioral capacity, then by extension, within the interpretive context of a particular community, a knowledge claim’s justification may be a statement that describes, in more concrete terms, the same (or an aspect of the same) behavioral capacity that the knowledge claim describes. In other words, a justification is implicated by a knowledge claim because the former describes a capacity that itself instantiates some aspect of the more general capacity described by the knowledge claim. In addition to being a logical extension of the possibility that knowledge claims and justifications both describe capacities, the idea is also strongly corroborated by a number of findings from the discourse analysis. Most importantly, it explains researchers’ difficulty resolving performance-competence issues, and differentiating between procedural and
The discursive functioning of knowledge claims in research studies

classical knowledge. This will be examined in greater depth later on. Before getting to that corroborating evidence, it is necessary to elaborate the idea that justifications describe the behavioral capacity that, in turn, is described more generally by the knowledge claims they justify.

If knowledge claims and justifications are descriptions of behavioral capacities and sub-capacities (i.e., instances of more general capacities), respectively, then they can be represented as hierarchically organized networks of increasingly general/broad capacities. This is shown in Figure 1, which portrays an example of the type of general hierarchical structure within which knowledge claims and justifications may be related.

---

27 These hierarchical networks can be thought of as the basis for discursive scripts used for describing/explaining/predicting children’s uses of numbers. For example, knowledge claims varying in generality within the same network might be incorporated into a script of the form: Marianne would be expected to do/know [less general knowledge claim] because she knows [more general knowledge claim].
The discursive functioning of knowledge claims in research studies

Figure 1. The general hierarchical structure of knowledge claims as descriptions of capacities
The discursive functioning of knowledge claims in research studies

Figure 1 shows the general hierarchical structure of knowledge claims as descriptions of capacities. Descriptions of more general capacities are closer to the top; descriptions of more concrete capacities are at the bottom. As this shows, hierarchical networks of knowledge claims may contain more than two levels, and a claim on one level may have an indefinite number of justifications (i.e., sub-knowledge claims or capacities that concretely instantiate the higher level knowledge claim).

This hierarchical structure to knowledge claims/justifications may not be immediately apparent in texts and other discourse. Knowledge claims and justifications may not be immediately adjacent, and discussions of multiple hierarchical networks of claims may overlap. Example 2 (the quote below) illustrates this, but also shows how the hierarchical structure may be discerned despite the discursive complexity typical of the analyzed texts. The example comes from the introduction of the text by Wynn (1990).

Example 2:

As a more stringent test of children's counting abilities under novel circumstances, consider all the types of entities other than objects that are countable: sounds, actions, abstract entities such as thoughts or mental representations, properties of objects, and so forth. There have been only a few studies of children's counting of entities other than objects. To determine how much of the list of number words their subjects could recite, Schaeffer et al. (1974) asked children to count to taps of a drum, saying a number word in time with each tap, for up to 10 taps. If the child increased the pace of saying the numbers, the experimenter increased the pace of drum tapping. The mean number of taps that their younger two groups of children (mean ages 3:5 and 3:8) counted to was about 6.5. In comparison, these children counted sets of one to four objects correctly about 74% of the time, and sets of five to seven objects correctly 43% of the time. They
The discursive functioning of knowledge claims in research studies

thus appear to count drum taps and objects about equally well, which suggests that they have an abstract, generalizable representation of counting. However, it is not clear what children considered the task to be, given that they were asked to count with the drum taps - were they actually counting the drum taps, or were they simply reciting a list in time to the beat of the drum? (Wynn, 1990, p. 159) [5-6; 27-4]

This passage can be deconstructed and represented in terms of several hierarchical networks of knowledge claims and justifications (i.e., networks in which more concrete claims are subsumed underneath more general claims). These networks are presented below.

Network 1

- [children] have an abstract, generalizable representation of counting. [5; 43] [i.e., abstract knowledge of the counting principles [4; 38-47]]
  - children [are able to demonstrate] counting abilities under novel circumstances [5-6; 27-4]
    - children [are able to count] entities other than objects [that are countable, e.g.,] sounds, actions, abstract entities such as thoughts or mental representations, properties of objects, and so forth. [5-6; 27-4]
    - [children] thus appear to count drum taps and objects about equally well, [5; 42]
    - Schaeffer et al. (1974) asked children to count to taps of a drum, saying a number word in time with each tap, for up to 10 taps. If the child increased the pace of saying the numbers, the experimenter increased the pace of drum tapping. The mean number of taps that their younger two groups of children (mean ages 3:5 and 3:8) counted to was about 6.5. In comparison, these children counted sets of one to four objects correctly
The discursive functioning of knowledge claims in research studies

about 74% of the time, and sets of five to seven objects correctly 43% of the time. [5; 32-37]

Network 2

• how much of the list of number words their subjects could recite, [5; 32]
  o Schaeffer et al. (1974) asked children to count to taps of a drum, saying a number word in time with each tap, for up to 10 taps. If the child increased the pace of saying the numbers, the experimenter increased the pace of drum tapping. The mean number of taps that their younger two groups of children (mean ages 3:5 and 3:8) counted to was about 6.5. In comparison, these children counted sets of one to four objects correctly about 74% of the time, and sets of five to seven objects correctly 43% of the time. [5; 32-37]

Network 3

• Counting the drum taps [5; 3] <<OR>> simply reciting a list in time to the beat of the drum? [5; 4]
  o Children were asked to count with the drum taps [5-6; 44-4] (PREVIOUSLY: Schaeffer et al. (1974) asked children to count to taps of a drum, saying a number word in time with each tap, for up to 10 taps. If the child increased the pace of saying the numbers, the experimenter increased the pace of drum tapping. The mean number of taps that their younger two groups of children (mean ages 3:5 and 3:8) counted to was about 6.5. [5; 32-37]

Networks 1-2 (above) show hierarchical structures of knowledge claims/justifications in which more concrete claims are nested beneath more abstract ones. Statements were assigned to higher or lower levels based on their position in the chain of supporting>supported claims. The
The discursive functioning of knowledge claims in research studies

intermediate level in Network 1 (i.e., *demonstrating counting abilities in novel circumstance*) was not well supported by the quoted text, and might have been merged with the claim immediately above it. It was kept separate on the grounds that the higher-level claim *an abstract generalizable representation of counting* could imply abilities beyond *demonstrating counting abilities in novel circumstances*.

Network 3 is unique in that it shows how a single justification can be a specific instantiation of two very different knowledge claims: *counting drum taps* and *simply reciting a list in time to the beat of the drum*. Thus, (relatively) more concrete claims are not necessarily exemplars of only one knowledge claim, but may be used to inductively generalize one of several different knowledge claims. An explicit argument given for choosing one or the other knowledge claim in network 3 would constitute an explanation.

5.5 Assessing the Validity of the Model Across Historical Periods

One consideration in selecting the texts for analysis in the current research was to ensure that the constructed model is valid across different historical periods. Specifically, the goal was to ensure that the functioning of knowledge claims as described by the prototype model produced in Study 1 was generalizable over a wider discursive context, not limited to a narrow context (e.g., certain discursive features found only within a short historical period). This was important because the prototype model constructed in Study 1 was based only on a relatively recent text (Sarnecka & Carey, 2008), and consequently may not have been typical of the use of knowledge claims over a broader historical period.

It is assumed as a given that discursive forms are continually changing, and that no specific discursive pattern is immutable. While the study of these changes has produced fascinating results (for an example, see Tabor (1995)), the goal of the current research is to identify patterns in the use of knowledge claims in a specific discourse (research texts on children’s understanding of number concepts) that are relatively stable. Moreover, the sampling
The discursive functioning of knowledge claims in research studies

method used in the current research is not nearly dense enough to reach reliable conclusions about historical changes in discourse. So, although it is assumed that the use of knowledge by researchers has changed in some ways over the period of time when the sampled texts were produced, the intention of the present analysis in selecting texts from multiple decades is to ensure that the conclusions drawn are those that are applicable across this entire era.

The analytic approach taken here was one that guaranteed, by default, that the ultimate model would be valid for the entire selection of texts, rather than just those from one or another era. Insofar as the model of knowledge claim functioning was derived from texts from different eras, it follows that the model should account for those texts, since if texts from a specific era were not accounted for by the model, this would have previously arisen as an issue in the analysis when those texts were being analyzed in the first place.

Even if the model does validly account for the use of knowledge claims across the different eras of texts, it still may be the case that the claims are used in different ways across different historical eras, albeit these differences would be ones that do not go beyond what is specified by the model. For example, it might be expected that there are differences across decades in terms of the types of knowledge claims that are given explicit justification, versus those that are left unjustified. These types of historical changes were analyzed. However, because the results did not ultimately have a significant effect on the conclusions of this research, they are discussed in Appendix 2.

Other evidence of historical changes in the use of knowledge claims in the analyzed texts can be found in Chapter 7. In that chapter, the reliability with which the model was applied to the analyzed texts is analyzed. The reported results of this analysis show both characteristics

28 For example, it would be reasonable to assume that the conclusions about numerical proficiency early in life reported by Gelman (1972) would be described in that and contemporary texts in more depth, reflecting the assumption of an audience that might be unfamiliar with these claims. More recent texts might be expected to describe these claims more briefly, given their high citation counts in the literature, and the resulting expectation that they are familiar for the intended audience.
The discursive functioning of knowledge claims in research studies

of the texts themselves, as well as the ways that the model’s categories were applied to them. These results, many of which are found in Tables 8-11, are reported for each selected text in chronological order, making it possible to view historical changes in the use of knowledge claims, and in the application of the model to texts from different eras.
CHAPTER 6: REVISED MODEL OF KNOWLEDGE CLAIM FUNCTIONING

6.1 Components and their Interrelationships in the Model of Knowledge Claim Functioning

The preceding analysis and interpretation has led to substantial changes in the model of knowledge claim functioning. It is therefore necessary to consolidate these gains for the sake of clarity, and describe the model as it is currently proposed. The current model describes the following set of components and their interrelations (these components are described in greater detail, with full criteria, in Appendix 6):

**Knowledge claim**: A description of a behavioral capacity (or its absence) at any level of generality. Knowledge claims are articulated on the basis of observations of behavior in settings that are presumed to facilitate the interpretation of that behavior. The category of knowledge claim subsumes *justifications*, and the latter term is taken to be a relative one, i.e., justifications are considered to be knowledge claims that instantiate (i.e., provide a specific instance of) more general knowledge claims. Examples of knowledge claims:

- *Understanding the cardinal principle*
- *Knowing how to count*
- *Not being able to count to five*
- *Knowing that the addition of an item to a set increases the set’s numerosity*
- *Accurately giving a requested number of items when asked*

**Justification**: A statement that is given as the direct reason or justification for asserting the knowledge claim. Justifications are, in all cases observed so far, knowledge claims or indirect descriptions of such. Thus, they are descriptions of behavioral dispositions, articulated in settings that are presumed to facilitate the interpretation of behavior. Examples (underlined, with knowledge claims in italics):
The discursive functioning of knowledge claims in research studies

- *Knows x because s/he passed the give-n task*
- It can be concluded that s/he can’t x because s/he consistently gave the wrong answer on the task intended to measure x.
- S/he *understands how to x because she passed the X task.*

**Explanation:** A statement that explains why a particular justification does/doesn’t provide valid grounds for the assertion of a knowledge claim. The four subtypes, which are too lengthy to describe here, are described with examples in Chapter 5, section 3.

**Redescription:** Rephrasing a knowledge claim/justification, possibly in a way that aligns it with a new hierarchical network of knowledge claims. Examples (before the redescription is italicized; after it is in bold, respectively):
- Passing the Give-N task doesn’t mean that a child *understands cardinality*; it may only mean that they have learned a *procedural rule for how to respond to requests for items using their counting sequence*.
- Young children may recite the counting list, but this doesn’t mean that they *understand counting*. It may only mean that they merely *know how to repeat a sequence of words*.

**Higher Level Knowledge Claims:** Higher level knowledge claims are claims about what a person knows (or about the knowledge itself—see Objectification, below) that are constructed on the basis of the overlapping or related implications of multiple knowledge claims. Example:
- As a result of observing the gradual or piecemeal achievement of behavioral capacities that exemplify certain aspects of the more general claim *understanding the cardinal principle*, it may be claimed that *knowledge of cardinality develops gradually*. This is a
The discursive functioning of knowledge claims in research studies

higher level claim insofar as it is constructed on the basis of lower level claims and their gradual achievement over time.

**Objectification**: Objectification involves the reification of knowledge described in a knowledge claim, i.e., treating the knowledge as if it were a thing. Conclusions that involve objectification are typically examples of higher level knowledge claims. Example (higher level claim is in bold):

- In the case of a child who inconsistently demonstrates that they understand the cardinal *principle* (i.e., a child who inconsistently accomplishes the relevant justifications for this knowledge claim), it may be claimed that their knowledge of cardinality is fragile.
The discursive functioning of knowledge claims in research studies

CHAPTER 7: VALIDITY AND RELIABILITY OF THE MODEL VIS A VIS THE SAMPLE

The categories and their relationships comprising the model were arrived at by analyzing all of the selected texts, i.e., the model is consistent with the use of knowledge claims in the selected texts. A comprehensive demonstration of how this is the case would be impractical, given the excessive amount of implicit detail involving the use of knowledge claims in the analyzed texts, which would need to be explicitly represented in such a demonstration. As an alternative way to demonstrate the validity of the model as a description of knowledge claims in the texts, and the extent to which it can reliably categorize those claims, a limited portion of each text was selected to be comprehensively represented in terms of the model. The sample is made up of the middle three paragraphs of the introduction/literature review sections of each of the selected texts. The specific page and line numbers included in these samples are listed in Appendices 9-19.

The introduction section was chosen because it tended to contain frequent and relatively discrete exemplars of knowledge claims, justifications, and explanations, as well as particularly complex and varied uses of these claims. While the content of the conclusion section was (for the current purposes) similar to the introduction, the latter tended to offer a greater depth, diversity and number of claims. The method and results sections of the articles also contained knowledge claims and justifications. However, in these sections, these statements—particularly justifications—didn’t exist in as discrete of a form, which would have been less than ideal for the analysis. As opposed to the introduction and conclusion sections, in which knowledge claims, justifications and explanations appeared discretely and in ways that highlighted their relationships to one another, the method sections tended to be taken up with extensive descriptions relevant only to a single justification at a time. Although the results sections often contained knowledge claims in addition to justifications, these components were related to each other in relatively basic ways, compared to their use in the introduction and conclusion, which
The discursive functioning of knowledge claims in research studies often considered the relationships between multiple justifications/knowledge claims and explanations.

The choice of three paragraphs in the middle of the introduction section was intended to direct the focus to specific, detailed arguments involving the use of knowledge claims, rather than the more general statements likely to be found at the beginning, or the descriptions of planned methodology found at the end.

The basic analytic categories of knowledge claim, justification and explanation listed above in the beginning of the current section were applied to knowledge claims in the selected three-paragraph samples.\(^{29}\) The criteria constituting each analytic category is described in greater detail in the coding manual in Appendix 6.

Characterizing the use of knowledge claims means constructing a comprehensive representation of the claims, their hierarchical interrelations with justifications, and the possible presence of any explanations in the selected text segments. This type of representation was shown earlier in the deconstruction of the quote from the Wynn article (example 2, and networks 1-3 in Chapter 5, Section 4.b.i).

The full results of this analysis are presented in Appendices 9-19. In each of these appendices, two separately elaborated representations for each of the selected articles can be found, and original and a copy. There are two representations for each as a result of assessing intra-rater reliability.

7.1 Intra-Rater Reliability

The main goal of analyzing these samples was to assess the reliability of coding the articles in terms of the main analytic categories. Reliability was assessed in terms of intra-rater (rather than inter-rater) reliability. While reliability is more often assessed with inter- rather than intra-rater reliability, the latter was appropriate for several reasons. First, the complexity of the

\(^{29}\) Only the three basic categories were used in order to reduce the complexity of the analysis, and because of various difficulties that arise in attempting to represent higher order knowledge claims, objectification and redescription.
The discursive functioning of knowledge claims in research studies

use of knowledge claims in the analyzed articles, the highly technical nature of the articles themselves, and the fact that substantial familiarity with the particular body of research literature was necessary for valid interpretation meant that extensive training and expertise would be required of an outside interpreter.

The second reason that intra-rater reliability was sufficient is that the results and conclusion of the current research are not directly tied to specific decisions in the coding process in the way they might be in other studies. For example, in a study where the conclusions involve the frequency or co-occurrence of certain coded categories, reliability is crucial for demonstrating that the patterns on which the conclusions are reached are not an artifact of a biased coding process. Since the current study did not involve these types of results/conclusions, it is less important that reliability be assessed with two or more individuals.

Of course, the results and conclusion of the current study are still related to the way that the analyzed texts were interpreted or coded. However, compared to a study like the one mentioned in the previous example, there is more transparency in the analysis and conclusions of the current research. For one thing, the data sources (i.e., the selected texts) are publically available. In addition, the process by which the results and conclusions were arrived at from these data is much more transparent than it would be in a study that, e.g., conducts statistical analyses on the frequency of coded categories. The approach taken in the current research is one that makes the conclusions publically verifiable. Any reader of the current study can assess the validity of the conclusions by analyzing claims about children’s knowledge in published research articles. In summary, since the data and the process of analysis and interpretation are open to verification by others, there is less of a need to demonstrate the reliability of the process through which they were reached with the rigor that inter-rater reliability provides.

7.1.a Measuring intra-rater reliability

While the results of the current study were derived from the analysis of a limited body of articles, it is hoped and anticipated that they are valid for other articles concerned with the same subject, and with the use of knowledge claims in research articles more generally.
The discursive functioning of knowledge claims in research studies

Intra-rater reliability was assessed by comparing the original representations of knowledge claims from the coded text segments provided in Appendices 9-19 with separately produced representations (labeled copy in each appendix) created two weeks later. Perfect reliability would mean that both representations of the same segment are identical, both in terms of the statements extracted as knowledge claims/justifications/explanations, and the organizational (hierarchical) relations between these.

To explain how reliability was assessed in terms of the similarity between the two representations, Figure 2 (below) will be used as a simplified example of what these pairs of representations looked like (for the actual pairs of representations created from each text sample, see Appendices 9-19). Figure 2 shows a pair of representations (A and B) ostensibly elaborated from the same text sample. Each shows two separate networks (1 and 2 in each representation) of hierarchical knowledge claims, and one explanation (E1). The code on the explanation is used to link it to citations (i.e., explanation citations), which are found throughout the representation, and indicate the knowledge claim justification pair that an explanation refers to (explanation citations are indicated next to the justification of the knowledge claim-justification pairing that they pertain to).
The discursive functioning of knowledge claims in research studies

7.1.b Characterizing Similarities and Differences Across Representations

Graph theory (Bondy & Murty, 1976), an area of discrete mathematics, provides a useful way to characterize hierarchical networks of knowledge claims, such as those shown in Figure 2. Importantly, graph theory provides tools for characterizing and analyzing the isomorphism or lack thereof between two corresponding representations or hierarchical networks.\(^{31}\) In the terminology of graph theory, each representation created from a text sample is a network comprised of a set of interconnected labels (networks are numbered “1” and “2” in Representations A and B). Each label occupies a given node. Nodes are the junctions between links, the latter referred to as edges. Although nodes and labels are distinct (the node is the junction between edges, the label is some content applied to that node), in the current case, for

---

\(^{31}\) The term network refers to a hierarchically linked set of knowledge claims/justifications. The term representation refers to the set of networks created to reflect all networks within a given text segment. Figure 2 contains two representations, each containing 2 networks.
The discursive functioning of knowledge claims in research studies

the sake of simplicity, the term *label* will be used to refer to the node and its content, unless otherwise specified.

A set of representations (or networks), such as the pairs of representations created from the text samples for the reliability analysis, may have features in common: repeated labels, and/or repeated edges. These are discussed and elaborated in the following sections.

7.1.c Repeated Labels

Repeated labels are labels (including knowledge claims/justifications, or explanations) that have the same meaning; i.e., are semantically equivalent. Equivalence, in this context does not mean exact identity, but approximate semantic equivalence between two statements. This was a necessary concession given the way that representations were created. In extracting statements (knowledge claims, justifications or explanations) from the text into the representation, statements from two different locations in the text often had to be grouped together, and this could be done in different ways by the rater working on two different occasions, yielding different wordings of statements that nevertheless had the same meaning. For example, the label created for a justification might be composed of several different phrases from the text that could be ordered in different ways with negligible change in meaning. (The actual similarity between labels in the paired representations can be assessed directly by comparing the representations themselves in Appendices 9-19.)

For example, in Figure 2, the statements *grasping the cardinal principle* and *understanding cardinality* (both numbered “1”) would constitute a pair of repeated labels. Even though they are not identically worded, they have approximately the same meaning. While these labels were in the same relative location (the top) in each representation, this was not a requirement for repeated labels, which could be in different locations in each corresponding representation. While such differences in location do reflect a lack of coding reliability, this will be accounted for in other ways, which are described below. The goal of identifying repeated labels is to demonstrate the extent to which the same components of the analyzed text
The discursive functioning of knowledge claims in research studies

segments were identified as knowledge claims/justifications/explanations, independently of how they were related to other such statements.

The similarity between explanations in corresponding representations was judged in much the same way as with knowledge claims/justifications. An explanation would be considered to be a repeated label if its meaning was equivalent to an explanation on the corresponding representation. Although explanations could be considered as labels, they will still be referred to as explanations (or repeated explanations), in order to differentiate them from knowledge claims/justifications, which will be referred to as labels.

7.1.c.i Asymmetrical Equivalence and Merged Claims. In some cases, two labels in a network in one representation would correspond (in terms of meaning) to a single label in a network on the other representation. An example of this is seen in Figure 2 in which the two lower-level labels (a and i) of network 1 in Representation A are merged into label a in representation B. In cases like this, each of the separated labels (i.e., 1.a and 1.a.i) and the single merged label (1.a) in Representation B would each count as repeated labels (a total of three). Merged claims count as repeated labels so long as all of the meanings merged within them correspond to labels in the other model. If the merged label included a non-repeated meaning, it (the merged label) would not count as a repeated label, although labels in the corresponding representation that did correspond to part of that merged label would still count.

7.1.c.ii Enumerating Equivalent Statements. A reference to a repeated or non-repeated label (or repeated/non-repeated explanation) pertains to individual knowledge claims/justifications or explanations that were found to be repeated in the corresponding representation. In other words, a repeated label is not the pair of repeated labels (although there has to be a pair), just one of the members of such a pair. So, a reference to “four repeated labels” does not mean four pairs of labels across two representations, but rather four labels within a single representation, each of which repeats a label in the corresponding representation.
The discursive functioning of knowledge claims in research studies

7.1.d Repeated Edges

In addition to repeated labels, the other dimension of isomorphism between representations involves the relations or edges between statements themselves. A repeated edge is a link between two labels on one representation that is also found in the corresponding representation. To say that an edge is repeated is to say that in two representations, two pairs of repeated labels are both linked by an edge in the same direction (i.e., the same labels are on the top/bottom in each representation). As this implies, all of the edges in one representation may be equivalent to the edges in another, even though the other representation may have a different number of edges. Additionally, the fact that all edges in one representation (x) are repeated edges does not mean that all edges in the corresponding representation (y) are repeated. To say that all edges in Representation x are repeated is merely to say that all of the same edges are found in representation y; representation y may contain additional non-repeated edges of its own.

To illustrate what is meant by an edge, consider Figure 2 once again. Representation A in Figure 2 contains 4 edges. This includes all directly linked labels (1>1.a; 1.a>1.a.i; 2>2.a), as well as indirectly linked edges (1>1.a.i) between non-adjacent labels. The only requirement is that the (direct or indirect) edges between statements be in the same direction, meaning that the same label must be on the top/bottom in corresponding representations.

All but one of the edges in both of the representations of Figure 2 are repeated edges—even though Representation A has two more edges than Representation B. The only non-repeated edge is 1.a>1.a.i, which is not found in Representation B because of those two labels being collapsed into each other. It is possible for all other edges in the two representations to be repeated because edges can be equivalent even if they connect to merged claims (e.g., 2>2.a), or are direct linkages in one representation and indirect linkages in the other (e.g., 1>1.a.i versus 2>2.a).
The discursive functioning of knowledge claims in research studies

Repeated edges are enumerated like repeated labels: a reference to a repeated edge refers to the edge between a knowledge claim and justification in a single representation which corresponds to a (second) edge in the other representation. Of course, in most cases the presence of a repeated edge implies the presence of another repeated edge in the corresponding representation (the exception would be if corresponding edge in the corresponding representation linked a merged claim containing non-repeated elements). In some cases a repeated edge does not necessarily correspond to a single link in a corresponding representation. For example, the edge 1>1.a in Representation B of Figure 2 corresponds to three repeated edges in Representation 1 (1>1.a and 1>1.a.i).

7.1.e Repeated and Non-repeated Explanation Citations

Repeated explanation citations refer to explanation citations in one representation whose location (i.e., placement on a particular label) corresponds to the placement of an explanation citation in the other representation. For example, in Figure 2, the explanation [E1] is cited next to equivalent labels in both representations. Therefore, Figure 2 would be said to contain a total of two repeated, and no non-repeated, explanation citations.

7.2 Findings Regarding the Equivalence Between Statements, Links and Citations in the Representations

The previously described forms of equivalence between statements can be used to report the extent of similarity between statements in the two representations created for this reliability analysis. These results are presented in Table 8 (below), which shows the number of total numbers of labels, repeated labels, non-repeated labels, and merged labels.

32 The only exception are repeated edges that correspond to edges between a repeated label and a merged claim that is partially non-repeated.
Table 8. Descriptive statistics on repeated/total labels, explanations, explanation citations, edges, and merged labels

<table>
<thead>
<tr>
<th>Appendix # (location of corresponding text)</th>
<th>Source Article</th>
<th>Repeated/Total labels (claims &amp; justifications)</th>
<th>Merged Labels</th>
<th>Repeated/Total Explanations</th>
<th>Repeated/Total Explanation Citations</th>
<th>Repeated/Total Edges</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Gelman (1972)</td>
<td>14/15</td>
<td>1</td>
<td>3/3</td>
<td>8/9</td>
<td>10/14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14/14</td>
<td>0</td>
<td>3/3</td>
<td>6/7</td>
<td>12/15</td>
</tr>
<tr>
<td>14</td>
<td>Gelman &amp; Meck (1983)</td>
<td>15/16</td>
<td>1</td>
<td>1/2</td>
<td>1/2</td>
<td>9/15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/18</td>
<td>1</td>
<td>1/1</td>
<td>1/1</td>
<td>10/19</td>
</tr>
<tr>
<td>9</td>
<td>Briars &amp; Siegler (1984)</td>
<td>15/18</td>
<td>2</td>
<td>5/5</td>
<td>9/14</td>
<td>16/31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13/14</td>
<td>0</td>
<td>5/5</td>
<td>10/10</td>
<td>14/16</td>
</tr>
<tr>
<td>18</td>
<td>Sophian (1988)</td>
<td>16/20</td>
<td>1</td>
<td>5/5</td>
<td>8/10</td>
<td>10/19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24/26</td>
<td>0</td>
<td>5/6</td>
<td>8/16</td>
<td>12/32</td>
</tr>
<tr>
<td>12</td>
<td>Frye, et al. (1989)</td>
<td>16/19</td>
<td>5</td>
<td>1/5</td>
<td>1/19</td>
<td>7/14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17/19</td>
<td>2</td>
<td>1/1</td>
<td>1/1</td>
<td>16/26</td>
</tr>
<tr>
<td>19</td>
<td>Wynn (1990)</td>
<td>31/32</td>
<td>2</td>
<td>3/3</td>
<td>5/8</td>
<td>29/54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26/26</td>
<td>0</td>
<td>3/3</td>
<td>3/4</td>
<td>34/42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4/4</td>
<td>0</td>
<td>2/2</td>
<td>2/2</td>
<td>2/4</td>
</tr>
<tr>
<td>15</td>
<td>Nikoloska (2009)</td>
<td>9/10</td>
<td>0</td>
<td>3/6</td>
<td>6/10</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6/7</td>
<td>2</td>
<td>3/3</td>
<td>5/8</td>
<td>3/5</td>
</tr>
<tr>
<td>10</td>
<td>Brooks, et al., (2012)</td>
<td>16/17</td>
<td>2</td>
<td>1/2</td>
<td>0/2</td>
<td>9/16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17/18</td>
<td>0</td>
<td>1/1</td>
<td>1/2</td>
<td>9/16</td>
</tr>
<tr>
<td>11</td>
<td>Davidson, et al. (2012)</td>
<td>19/19</td>
<td>3</td>
<td>5/5</td>
<td>7/8</td>
<td>10/10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26/26</td>
<td>0</td>
<td>5/5</td>
<td>10/11</td>
<td>12/15</td>
</tr>
<tr>
<td>17</td>
<td>Sarnecka &amp; Wright (2013)</td>
<td>20/20</td>
<td>3</td>
<td>2/2</td>
<td>5/6</td>
<td>7/11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17/18</td>
<td>3</td>
<td>2/3</td>
<td>5/6</td>
<td>5/8</td>
</tr>
</tbody>
</table>

Table 8 shows the number of repeated and total labels explanations, explanation citations, and edges (the number of non-repeated entities can be inferred), as well as the number of merged statements. Each row contains the data from both representations created from a single source article. Data corresponding to the original representation are on the top row. Data from the second (copy) representation are on the lower row.
The discursive functioning of knowledge claims in research studies

7.3 Similarity of Representations Relative to Chance

The results reported in Table 8 provide a way to look at the similarity of statements and relations between them across the pairs of representations created from each text segment. However, what is lacking is any indication of the extent to which this relative similarity differs from chance. To what extent would a randomly constructed second representation resemble the first? This question is especially pertinent to the equivalence of relations between statements. While more of the links in each representation were equivalent than non-equivalent, to what extent could this have been due to chance?

To calculate this probability, consider first that each representation created for this analysis has some number of actual repeated edges \( r \) (i.e., the number of edges that mirror those found in the corresponding representation), and (in most cases) some number of actual non-repeated edges. These actual repeated and non-repeated edges are a subset of the total number of possible edges \( T \), between the various labels in the representation. The total number of possible edges also includes all non-repeated and repeated edges that were not found in the representation, but which could have been implemented between its members. The total possible repeated edges, \( R \), includes all possible (and actual) edges that would be considered repeated, as a result of their corresponding to (actual) edges in the corresponding representation. As this implies, it was not possible to deduce \( R \) from the other values in Table 8. \( R \) had to be calculated by determining possible repeated links that would result from both (1) duplications of existing repeated links \( r \) resulting from duplicate labels, and (2) repeated links that were not implemented, but could have been, between the labels in a given representation.

If there are \( n \) labels, then the total number of possible edges \( T \) that could be implemented between them equals \( n(n-1)/2 \). The total \( T \) is reached by dividing by two, not because the edges are bidirectional (in fact, they are unidirectional), but because the networks cannot be circular. While a statement may function as a justification for one claim and a knowledge claim relative to another, the same claim cannot be higher and lower level (a
The discursive functioning of knowledge claims in research studies

knowledge claim and a justification) with respect to itself, or to any other particular statement. While a randomly implemented set of edges would not necessarily have to follow these rules, excluding these possibilities makes the current calculations of the likelihood of getting repeated edges by chance more conservative, since none of the excluded edges would have been repeated edges, so, if they had been included, this would lower the obtained probability values.

To calculate the probability \( p \) of a representation with at least \( r \) repeated labels occurring by chance, the following equation was developed specifically for the current study:

\[
p = \sum_{j=0}^{t-r-1} \left( \prod_{i=0}^{j} \frac{(R-i)}{(T-i)} \right) \left( \prod_{k=0}^{t-1} \frac{(T-R-k)}{(T-r-j)} \right) \frac{t!}{(r+j)!(t-r-j)!}
\]

in which \( R \) and \( r \) are the numbers of possible and actual repeated edges, respectively, and \( T \) and \( t \) are the number of possible and actual edges, respectively. The results of these calculations for one member\(^{33}\) of each pair of representations created for this reliability analysis are found below in Table 9.

This probability calculation does not produce the probability of getting a given number of repeated edges given the random assembly of both representations. Rather, it gives the odds of getting at least a given number of repeated edges \( (r) \) on one representation if that representation’s \( t \) edges are randomly reassigned to any of the \( T \) possible connections between its labels. Repeated edges are, once again, defined relative to the corresponding member of any pair of representations.

\(^{33}\) These probabilities must be calculated individually for each representation, rather than once per pair, because the probability of getting the number of repeated edges in each member of a pair is (most likely) different. Even if both representations have the same number of total and repeated edges, the odds may be different if the representations do not share the same labels.
Table 9. Descriptive statistics and probabilities for actual/possible edges and repeated edges

<table>
<thead>
<tr>
<th>Appendix #</th>
<th>Source Article</th>
<th>Actual/Possible edges (t/T)</th>
<th>Actual/Possible Repeated Edges (r/R)</th>
<th>Probability of at least r repeated edges</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Gelman (1972)</td>
<td>14/105</td>
<td>10/15</td>
<td>0.0000084%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/105</td>
<td>12/20</td>
<td>0.0000022%</td>
</tr>
<tr>
<td>14</td>
<td>Gelman &amp; Meck (1983)</td>
<td>15/120</td>
<td>10/15</td>
<td>0.0000024%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19/153</td>
<td>12/20</td>
<td>0.0000015%</td>
</tr>
<tr>
<td>9</td>
<td>Briars &amp; Siegler (1984)</td>
<td>31/153</td>
<td>16/31</td>
<td>0.00075%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16/91</td>
<td>14/31</td>
<td>0.00018%</td>
</tr>
<tr>
<td>18</td>
<td>Sophian (1988)</td>
<td>19/190</td>
<td>10/27</td>
<td>0.0024%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32/325</td>
<td>12/40</td>
<td>0.0077%</td>
</tr>
<tr>
<td>12</td>
<td>Frye, et al. (1989)</td>
<td>14/171</td>
<td>7/11</td>
<td>0.00013%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>26/153</td>
<td>16/16</td>
<td>2.8x10^-13%</td>
</tr>
<tr>
<td>19</td>
<td>Wynn (1990)</td>
<td>54/496</td>
<td>29/61</td>
<td>8.2x10^-14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37/325</td>
<td>32/57</td>
<td>1.0x10^-21%</td>
</tr>
<tr>
<td>16</td>
<td>Sarnecka &amp; Carey (2008)</td>
<td>4/10</td>
<td>3/4</td>
<td>11.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2/6</td>
<td>2/3</td>
<td>20%</td>
</tr>
<tr>
<td>15</td>
<td>Nikoloska (2009)</td>
<td>5/45</td>
<td>4/8</td>
<td>0.21%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5/36</td>
<td>3/4</td>
<td>0.53%</td>
</tr>
<tr>
<td>10</td>
<td>Brooks, et al. (2012)</td>
<td>16/120</td>
<td>9/11</td>
<td>0.0000053%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16/136</td>
<td>9/16</td>
<td>0.000026%</td>
</tr>
<tr>
<td>11</td>
<td>Davidson, et al. (2012)</td>
<td>10/171</td>
<td>10/32</td>
<td>0.0000014%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/325</td>
<td>12/31</td>
<td>2.3x10^-9%</td>
</tr>
<tr>
<td>17</td>
<td>Sarnecka &amp; Wright (2013)</td>
<td>11/190</td>
<td>7/19</td>
<td>0.00080%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8/136</td>
<td>5/14</td>
<td>0.025%</td>
</tr>
</tbody>
</table>

Table 9. The numbers of actual/possible edges, repeated edges, and the probability of getting at least as many actual repeated edges by chance, for each representation. Values from the original representation are on the top; those from the copy are on the bottom.

As the results in Table 9 show, the number of repeated edges obtained in each of the representations is statistically significant, except where the ratio of possible repeated edges to possible edges is high, and the number of total actual and possible edges is low; i.e., in the Sarnecka & Carey (2008) article. These generally low probabilities suggest that networks of knowledge claims/justifications (which are the unit of analysis of the current research) may be reliably constructed, meaning that the grouping of certain claims into networks, and the organization of links (edges) within those networks can be implemented reliably. While the
The discursive functioning of knowledge claims in research studies

reported probabilities are for each individual representation, the actual probability of these results overall would be lower—specifically, it would be the product of all the individual probabilities.

7.3.a Reliability in the use of explanation categories. A final dimension of reliability that can be assessed concerns the assignment of explanation categories. So far the focus has been on the similarity of the explanation statements themselves (whether each explanation in each representation was shared or unshared); it is another matter whether a shared explanation was reliably categorized as given type of explanation: Type 1a, 1b, 2a, or 2b. Because each explanation could be categorized as one of four types, and for each shared explanation from each representation, only one of these category assignments would be reliable, the odds of randomly obtaining the observed frequencies of explanation-type assignments were calculated using a cumulative binomial distribution. These results are shown in Table 10 (below).
The discursive functioning of knowledge claims in research studies

Table 10. Number of possible and actual shared explanation category assignments for each article

<table>
<thead>
<tr>
<th>Appendix #</th>
<th>Source Article</th>
<th>Possible/actual shared explanations with shared category assignments</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Gelman (1972)</td>
<td>3 / 3</td>
<td>1.5625%</td>
</tr>
<tr>
<td>14</td>
<td>Gelman &amp; Meck (1983)</td>
<td>1 / 1</td>
<td>25%</td>
</tr>
<tr>
<td>9</td>
<td>Briars &amp; Siegler (1984)</td>
<td>5 / 5</td>
<td>0.09765625%</td>
</tr>
<tr>
<td>18</td>
<td>Sophian (1988)</td>
<td>5 / 5</td>
<td>0.09765625%</td>
</tr>
<tr>
<td>12</td>
<td>Frye, et al. (1989)</td>
<td>1 / 1</td>
<td>25%</td>
</tr>
<tr>
<td>19</td>
<td>Wynn (1990)</td>
<td>3 / 3</td>
<td>1.5625%</td>
</tr>
<tr>
<td>16</td>
<td>Sarnecka &amp; Carey (2008)</td>
<td>2 / 2</td>
<td>6.25%</td>
</tr>
<tr>
<td>15</td>
<td>Nikoloska (2009)</td>
<td>3 / 1</td>
<td>57.8125%</td>
</tr>
<tr>
<td>10</td>
<td>Brooks, et al., (2012)</td>
<td>1 / 0</td>
<td>100%</td>
</tr>
<tr>
<td>11</td>
<td>Davidson, et al. (2012)</td>
<td>5 / 5</td>
<td>0.09765625%</td>
</tr>
<tr>
<td>17</td>
<td>Sarnecka &amp; Wright (2013)</td>
<td>2 / 1</td>
<td>4.375%</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>31 / 27</td>
<td>0.00000000001%</td>
</tr>
</tbody>
</table>

The middle column of Table 10 lists the number of possible and actual shared explanation category assignments for each article. *Shared explanations with shared category assignments* are shared explanations (identical explanations found in both representations created from the same text) that are also categorized as the same type of explanation (i.e., both members of a pair of shared explanations are given the same category label, e.g., both are labeled Type 1a). The number of *Possible shared explanations with shared category assignments* is always the same as the number of shared explanations, since this reflects the value obtained if all shared explanations were categorized in the same way. The “actual” value may be equal to or less than the possible value, depending on whether or not any pairs of shared explanations were given different category assignments. The probability value in the far right column reflects the probability of getting at least the number of actual shared category assignments by chance. The overall values in the final row reflect the probability of obtaining the total sum of possible/actual values. Because the number of shared explanations was the same across both representations, the values in the table are the same for the original and copy representation, and consequently only one value is given.

The results in Table 10 show the reliability of assignment of explanation categories across the two representations created for this reliability analysis. While the assignment of categories was not significant for five out of 11 articles individually, this is to be expected from the low values involved: in fact, in 3/5 of the cases in which probability values exceeded 5% had perfect reliability (for assigning explanation categories). The overall probability, calculated from the sums of possible and actual values (27 out of 31 category assignments were consistent across

34 That is, probability of getting the observed level of reliability (consistency) in assigning explanation categories by chance exceeded 5% for 5/11 of the analyzed articles.
The discursive functioning of knowledge claims in research studies representations), was highly significant (0.0000000001%). Consequently, it can be concluded that the assignment of explanation categories was reliable.

7.4 Reliability of Model across Historical Periods

The results previously reported on Tables 8-10 are arranged chronologically (by the publication date of the analyzed article). This provides a way to analyze possible historical changes in the use of knowledge claims in the analyzed texts, and in the use of the model to analyze them. While the overall goal of the current research was not to analyze historical changes in discourse (after all, the selection of texts is grossly insufficient to allow for any meaningful conclusions about diachronic change), the historical dimension is important insofar as it provides a way to assess how the model generalizes to the use of knowledge claims in research articles from several different decades.

The chronological presentation of results on Tables 8-10 makes it possible to observe several things. First, it is possible to observe historical changes in the use of certain features of knowledge claim discourse, e.g., the frequency of knowledge claims/justifications, and explanations relative to each other. (It should be noted that values from Tables 8-11a cannot be directly compared across texts, because the values are derived from text segments of differing lengths. For the sake of comparison across texts, standardized values can be found on Table 11B.)

In addition to data on historical changes in the frequencies of different aspects of the knowledge claim discourse, it is also possible to assess the extent to which the model was applied reliably (consistently) as a function of historical era of analyzed text. The probability values found on Tables 9 and 10 quantify the extent to which the model was applied reliably, in terms of the likelihood that the similarity between the two constructed representations could have been arrived at by chance. Although the small number of analyzed articles, as well as the differences in degrees of freedom for the calculations for each article, precludes drawing any positive conclusions about a relationship between reliability and year, the fact that these values
The discursive functioning of knowledge claims in research studies are mostly very low suggests that the model can be reliably applied to at least some articles from the 1970s/1980s through the 2000s. Although some of the observed probability values are not significantly different from what might be expected by chance, these (in every case) resulted from implementations of the model with few degrees of freedom. Given that the probabilities tended to be much lower overall, it is reasonable to assume that any high probability values reflect limited degrees of freedom, rather than an unreliable model.

7.4.a Integration of Knowledge Claims within Hierarchical Networks

Another dimension of knowledge claim discourse that can be analyzed across historical periods is the depth of the networks of knowledge claims observed in the analyzed text segments. Depth refers to the number of hierarchical levels or layers in the networks of knowledge claims constructed for each text segment. For example, knowledge claims that were neither asserted with a justification (lower level knowledge claims), nor serve as justifications for any higher level claims, are part of a network with only one level. If a knowledge claim is justified, then its network has at least two levels—the justification and the claim. If a network has at least one middle level claim that is justified by a lower level claim, and also justifies a higher level claim, it has at least three levels.

Table 11a and 11b show the number of networks of knowledge claims with a given depth (1-6) for the representations from each of the text samples from the reliability analysis. The two tables present different versions of similar data. Table 11a presents the number of networks of a given depth, and the average\(^{35}\) number of knowledge claims/justifications (labels) found in networks at each depth level, for each text. The observed number of networks with a given depth for each text sample is affected by the length of the sample, and consequently, these values cannot be compared across texts. To allow comparison across texts, Table 11b presents the average of the values from the two representations. Hence, the number of networks of a given depth is not always a whole number.

\(^{35}\) Since two representations were constructed from each text, the values for the number of networks at a given depth, and the number of claims per network of a given depth are the average of the values from the two representations.
The discursive functioning of knowledge claims in research studies provides standardized values, arrived at by dividing the number of networks of each depth level by the length of the text sample they were derived from, and multiplying by 100 (the values for the number of claims per network were not standardized, since these are not related to the original length of the text sample). Thus, the results show the number of networks for each depth level, as well as the overall number of labels and explanations per 100 words.
Table 11a. Knowledge Claims and Justifications in Older and Newer Texts

<table>
<thead>
<tr>
<th>Appendix # (location of corresponding text)</th>
<th>Source Article</th>
<th>Network Depths</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Gelman (1972)</td>
<td>2.5</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>.5</td>
<td>6</td>
</tr>
<tr>
<td>14</td>
<td>Gelman &amp; Meck (1983)</td>
<td>.5</td>
<td>1</td>
<td>6</td>
<td>3.17</td>
<td>1</td>
<td>4.5</td>
<td>0</td>
<td>n/a</td>
</tr>
<tr>
<td>9</td>
<td>Briars &amp; Siegler (1984)</td>
<td>.5</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>Sophian (1988)</td>
<td>.5</td>
<td>1</td>
<td>3.5</td>
<td>2.71</td>
<td>.5</td>
<td>10</td>
<td>.5</td>
<td>17</td>
</tr>
<tr>
<td>12</td>
<td>Frye, et al. (1989)</td>
<td>5.5</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
<td>.5</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>Wynn (1990)</td>
<td>1.5</td>
<td>1</td>
<td>3</td>
<td>2.5</td>
<td>1</td>
<td>4</td>
<td>.5</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>Sarneck &amp; Carey (2008)</td>
<td>.5</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>Nikoloska (2009)</td>
<td>1.5</td>
<td>1</td>
<td>3</td>
<td>2.67</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Brooks, et al., (2012)</td>
<td>4</td>
<td>1</td>
<td>2.5</td>
<td>2.2</td>
<td>.5</td>
<td>3</td>
<td>1</td>
<td>6.5</td>
</tr>
<tr>
<td>11</td>
<td>Davidson, et al. (2012)</td>
<td>3.5</td>
<td>1</td>
<td>6</td>
<td>2.75</td>
<td>.5</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>Sarnecka &amp; Wright (2013)</td>
<td>2.5</td>
<td>1</td>
<td>6.5</td>
<td>2.23</td>
<td>.5</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 11a shows the number of networks of a given depth for each of the segments of the 11 selected texts, and the average number of claims in the network for each depth level. Each value is averaged across the two representations constructed from each text sample, hence the lack of whole numbers for some of the values. “Depth” refers to the number of hierarchical levels in a network of knowledge claims. For instance, a knowledge claim with a single justification would have a depth of 2. If that justification were itself justified by a lower level justification, the depth would be 3.
Table 11b. Average number of networks by network depth

<table>
<thead>
<tr>
<th>Source Article</th>
<th>Network Depths</th>
<th>Frequency counts of claims/justifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>13 Gelman (1972)</td>
<td>0.60 1</td>
<td>0.36 2</td>
</tr>
<tr>
<td>14 Gelman &amp; Meck (1983)</td>
<td>0.09 1</td>
<td>1.13 3.17</td>
</tr>
<tr>
<td>9 Briars &amp; Siegler (1984)</td>
<td>0.17 1</td>
<td>0.51 2</td>
</tr>
<tr>
<td>18 Sophan (1988)</td>
<td>0.10 1</td>
<td>0.70 2.71</td>
</tr>
<tr>
<td>12 Frye, et al. (1989)</td>
<td>1.33 1</td>
<td>0.36 2</td>
</tr>
<tr>
<td>19 Wynn (1990)</td>
<td>0.23 1</td>
<td>0.45 2.5</td>
</tr>
<tr>
<td>16 Sarneka &amp; Carey (2008)</td>
<td>0.15 1</td>
<td>0.30 4</td>
</tr>
<tr>
<td>15 Nikoloska (2009)</td>
<td>0.55 1</td>
<td>1.10 2.67</td>
</tr>
<tr>
<td>10 Brooks, et al., (2012)</td>
<td>0.71 1</td>
<td>0.45 2.2</td>
</tr>
<tr>
<td>11 Davidson, et al. (2012)</td>
<td>0.50 1</td>
<td>0.86 2.75</td>
</tr>
<tr>
<td>17 Sarneka &amp; Wright (2013)</td>
<td>1.02 1</td>
<td>2.65 2.23</td>
</tr>
</tbody>
</table>

Table 11b shows the number of networks of a given depth for each of the segments of the 11 selected texts, and the average number of claims in the network for each depth level. “Depth” refers to the number of hierarchical levels in a network of knowledge claims. For instance, a knowledge claim with a single justification would have a depth of 2. If that justification were itself justified by a lower level justification, the depth would be 3. Each value is averaged across the two representations constructed from each text sample, hence the lack of whole numbers for some of the values. Values are standardized to compensate for the differing lengths of the original text samples, and reflect the incidence per 100 words (i.e., values from Table 11a were divided by the number of words from its text sample and multiplied by 100). Values for the “average number of claims in each network” are not standardized, since these would not be affected by the length of the original text sample.
CHAPTER 8: SUMMARY OF RESULTS AND EMERGING ISSUES

8.1 Summary

The goal of the current study was to investigate how knowledge claims function—specifically the ways that asserted (or contested) knowledge claim are justified, and what it is that makes particular justifications valid. The analysis of research texts has provided clear answers to these questions: The results suggest, first of all, that knowledge claims are descriptions of behavior. This, in turn, provides a way to explain why particular types of statements constitute valid justifications for a given knowledge claim: valid justifications are more concrete descriptions of some aspect of the same behavioral capacity described by the knowledge claim they justify. One implication of this is that studying children’s behavior in order to infer what they know can be described as an attempt to make general claims about how children behave on the basis of observing some specific behavioral performances.

These conclusions are repeatedly corroborated by the ways knowledge claims were used in the analyzed texts. The following findings provided particularly strong corroboration:

1. Knowledge claims were found to be intuitively/normatively linked with certain forms of behavior, the performance of which provided the conditions for the assertion of the knowledge claim (originally reported in Chapter 4, section 3). Although explanations were sometimes given to account for why some particular behavior was (or was not) grounds for the assertion of a given knowledge claim, these explanations often presupposed the relevance of the behavior to the knowledge claim in question, rather than establishing it “from scratch.”

2. Knowledge claims and justifications functioned in overlapping ways and in many cases were interchangeable with each other (results originally reported in Chapter 5, section 4). At the same time, justifications were almost always descriptions of concrete forms of performed behavior. (This supports the overall conclusions because, insofar as the knowledge claims and justifications are interchangeable, and the latter are arguably
The discursive functioning of knowledge claims in research studies

descriptions of behavior, this suggests that knowledge claims are descriptions of
behavior as well.)

3. An observed failure to perform just one kind of behavior used as grounds for the
assertion of a knowledge claim would jeopardize the validity of the entire claim. The
possibility of continuing to assert the claim was, in every case of inconsistent
performance, contingent on redescribing the inconsistently achieved behavior (results
reported in Chapter 4, section 3, and Chapter 5, section 3.

4. Knowledge claims that did not appear to describe behavior were justified by a wide
range of behavioral performances. Because of this, and because these claims
functioned otherwise as if they were descriptions of behavior, it is reasonable to
conclude that what were ostensibly descriptions of knowledge rather than behavior were
in reality just highly generalized descriptions of behavior (further explained in Chapter 5,
section 4).

These four findings provide particularly strong corroboration for the idea that knowledge
claims and justifications are hierarchically nested descriptions of behavior because, despite
addressing different aspects of knowledge claim functioning, they all point to a common
conclusion. The conclusion raises a number of issues, which are discussed in Chapters 8-9.
Chapter 8 deals primarily with the model itself. The broader significance of the current findings
in relation to relevant academic literature is discussed in Chapter 9.

8.2 Use of the Model to Characterize the Use of Knowledge Claims in Different Cultural-
Historical Contexts

Language use is always in flux, and any local characteristics of human discourse may
change over historical time. Therefore, it is not possible to assert that the model produced here
will “always be valid.” It is entirely possible that researchers may shift their discursive practices
The discursive functioning of knowledge claims in research studies

in such a way that their discourse on knowledge is no longer characterized by the model. Certainly there was some previous era during which “knowledge” was not talked about in the ways described by the current model.

Having noted these limits, the model is intended to be valid across some range of cultural-historical variability. It was developed out of a prototype model described in Study 1 (Chapter 4), which was refined and assessed through the analysis of additional texts (Study 2; Chapter 5). These additional texts came from different researchers, journals, and historical periods. This diversity was intended to bolster the validity and reliability of the model, enhancing the range of the use of knowledge claims that it describes.

Regardless of whether we examine knowledge claims in Gelman’s (1972) “early” article, or in the more recent work of Sarnecka and Wright (2013), the model identifies a common set of characteristics in the use of knowledge claims. While there are certainly changes in this discourse\(^{36}\), the types of changes expected over a short time are not of the sort that would likely invalidate the model. (Appendix 2 contains an analysis of such changes.) Changes that would invalidate the model would be the sort of lexical changes that occur over centuries and lead words or phrases to be used in distinct ways.

An example of this type of change is given by Tabor (1995), who, through a comprehensive historical analysis, charted a shift in the use of the verb to go. Five hundred years ago, to go was only used only to describe literal movement. In the intervening time, the phrase be going to has come to be used increasingly commonly as a marker of the future (e.g., I’m going to Arizona [next year]). Today, phrasings such as I’m going to the store are

---

\(^{36}\) One likely change that could be unearthed through analysis would be cultural-historical shifts in what is assumed (by the author about the audience) to be understood, what is treated as needing justification, versus what is asserted without justification. The model has been designed to account for these shifts insofar as it can represent knowledge claims that are justified, knowledge claims that are not justified, as well as justifications that are themselves justified, or knowledge claims that serve as justifications for other (higher level) knowledge claims. While the same knowledge claim/justification may be used in any of these ways in different discursive contexts, this does not cause problems for the model, since the model makes no specific predictions about which claims are justified and which are not.
ambiguous—they may describe one’s current movement towards the store, or the fact that one will be at the store in the future, but is not in the present. Tabor’s findings also suggest that exceptions and irregularities in the use of knowledge claims may be indicative of large scale historical changes whose course is not evident to the myopia of the present. Such irregularities may be an important future topic for research on knowledge claims.

If the types of changes Tabor describes were to occur with the verb *to know* (or related verbs), this could invalidate the model as formulated here, insofar as the model is based on the idea that knowledge claims are descriptions of behavioral dispositions, articulated in response to situations that are presumed to allow general interpretations of observed behavior. However, across the range of texts that was the focus of the current analysis, such changes were not evident. The types of changes that would be more likely to occur over the short duration of several decades are those that do not require fundamental changes to the model. Several of these are discussed at the end of chapter 7, as well as in Appendix 2.

Overall, while the current model does not predict all aspects of the specific ways that knowledge claims are used within specific communities (i.e., predictions about what is assumed to be understood, etc.), it does provide a general model that can apply across some variety of communities, hopefully for the next several decades or more. This type of general applicability is crucial in the social sciences, which has struggled to make useful generalizations about human social life, given the latter’s dynamic variability (Gergen, 1973; Meehl, 1978).

### 8.3 Separation of Competence and Performance and the Objectification of Knowledge

#### 8.3.a Making Sense of “Competence Before/After Performance” Claims

Some of the most salient issues raised by the model address the distinction between competence and performance. In particular, the model raises the following question: If knowledge claims are descriptions of behavioral dispositions, then how are researchers able to distinguish between competence (or conceptual knowledge) and performance (behavior)? In particular, how it is possible to make the claim that competence precedes performance? This is
The discursive functioning of knowledge claims in research studies

an issue for the following reason: If knowledge claims are descriptions of behavioral capacities, then all they describe is a capability for performance. To say that someone has knowledge but cannot demonstrate it in performance would therefore be a contradiction in terms.

Even though they contradict the model, competence-before-performance arguments (e.g., the principles-first position) arise in response to issues that are accounted for by the model. Specifically, in the analyzed texts, these arguments arose in response to inconsistent patterns of behavior (non-concurrent achievement) across measures of the same form of knowledge/competence. From the standpoint of the model, these inconsistent patterns are the inconsistent achievement of forms of behavior exemplifying a description of some generalized behavioral capacity, and their inconsistency means that the behavioral generalization cannot be validly asserted.

Arguments about competence preceding performance imply an alternative view in which knowledge is a real entity separate from behavior or its description. According to this alternative view, inconsistent achievement of the forms of behavior that ostensibly imply some form of knowledge does not make the assertion of the knowledge claim a moot point (which they should do according to the model), but are, rather, taken to suggest that one or more of the performances/actions (which serve as justifications) is an invalid measure of the knowledge. This leads to attempts to determine what is a valid measure of the knowledge in question. The way that this is done, and the issues that arise in this search, are precisely what one would expect if the knowledge in question were simply a generalized description of a behavioral capacity.

First, possibly valid alternative behavioral measures can be generated a priori. While it is not clear how researchers would choose specific behavioral indices of knowledge if the latter were construed as some sort of cognitive entity (i.e., somewhat distinct from action or its control), such choices are readily explained if we assume that the knowledge claim is a generalized description of behavior.
The discursive functioning of knowledge claims in research studies

Secondly, these new behavioral measures are necessarily (at least in principle) subject to the same sorts of issues that invalidated the measures they were brought in to replace: any behavioral measure can be claimed to involve extraneous performance requirements, or to be carried out by rote (or invalidated for some other reason). Insofar as there are facets of any performance that could be labeled “performance demands”, or insofar as any action could be performed for more than one reason, it is not at all clear what a valid measure of knowledge would or could look like. This second set of issues is also easily resolved by the model, according to which there are no valid measures of knowledge, only performances that instantiate various descriptions of more general forms of behavior.

The use of redescription in response to a lack of expected concurrent validity between measures of a knowledge claim is also readily accounted for by the model. After redescribing either an unachieved behavioral performance as involving additional performance demands, or an achieved behavioral performance as having been carried out by rote, researchers asserted that the participants in question lacked or had (respectively) a given form of knowledge. The model accounts for why redescription was able to accomplish this: Redescribing one or more inconsistent behavioral performances “unlinks” them from a given knowledge claim, providing a consistent basis for the assertion of the claim.

The fact that inconsistent performances on ostensible measures of some form of knowledge are met with arguments about performance preceding/following competence is intriguing. On one hand, these arguments end up creating the impression that knowledge exists independently of the behavioral performances with which it is associated. Yet, this impression is misleading. As the previous analysis of Type 1a explanations shows, the discursive processes that are used to create the ostensible separation between competence and performance are derived from a language game within which knowledge claims are fundamentally descriptions of behavioral capacities. Therefore, even though this fact may be obscured by certain discursive practices, the separation of competence and performance is an illusion. While this illusion leads
The discursive functioning of knowledge claims in research studies

researchers to try to infer competence from performance, these efforts are bound to fail. The reason for this is that, as has been repeatedly shown here, there is no criteria for a competence besides some kind of performance, yet at the same time, any performance proposed as a measure of some competence can be claimed to involve extraneous performance demands that are irrelevant to the competence in question.

The impossibility of reaching a definite answer to problems of performance versus competence is obscured by the objectification of knowledge. At the same time, the assumption that the knowledge described in a knowledge claim is an objective thing leads directly to the problematic competence-performance debates, as well as to the assumption that definitive answers concerning what a person knows can be reached.

8.3.b Objectification

As was previously mentioned, competence-performance distinctions come into use in response to findings (or anticipated findings) showing a mix of achievement and failure across the various performances implicated by a given knowledge claim, as opposed to across the board success or failure (which would be implied by the truth or falsity of the knowledge claim, respectively). According to the model of knowledge discourse developed here, such “mixed results” mean that a given knowledge claim is invalid or inapplicable—neither fully true nor false.

The objectification of knowledge obscures these facts by creating the impression that the knowledge is a thing that exists apart from the discourses in which it is talked about, and the behavioral performances to which it pertains. This inverts the relationship between knowledge and behavior. Rather than, as the model claims, knowledge being a generalization of behavioral capabilities, the objectification of knowledge engenders the impression that knowledge exists regardless of whether or how it is reflected in behavioral capabilities. This is evident in cases in which researchers have abundant evidence of children’s behavioral proficiency to use numbers, but treat the issue of “what they know” as a separate and unresolved matter. Several examples of this are discussed in Appendix 7.
The discursive functioning of knowledge claims in research studies

8.4 Inductive Inferences About Knowledge

In addition to the question of the performance-competence distinction, the second issue raised by the model concerns the role of inductive inferences in conclusions about children’s knowledge. In the model, both inductive and deductive inferences may be drawn contingent on the truth of a given knowledge claim. If a given knowledge claim \( k \) is assumed to be true, it may be deduced that a more specific aspect of the capacity described by \( k \) (i.e., one of \( k \)’s justifications) is also true. On the other hand, since inductive inferences are not necessarily true, the truth of \( k \) would not necessarily imply the truth of a more general capacity that subsumes \( k \), since this more general capacity implies additional capacities besides \( k \) which may or may not obtain (i.e., may or may not be capacities that the person in question actually has).

In other words, deductive conclusions would start from the assumed truth of a given knowledge claim, and draw conclusions about specific behavior (concrete instances of the assumed-true knowledge claims). An example of such a deductive inference might be to conclude that a child knows how to count marbles because he or she knows how to count in general.

Interestingly, despite the limitations of inductive inferences, the model implies that conclusions about children’s knowledge in the analyzed research articles must be reached inductively, rather than deductively. In the analyzed texts, deductive inferences were used to select behavioral performances that would be evidence of more general knowledge claims. However, it is not possible for deductive conclusions like this to be reached definitively (i.e., as the conclusions of the research itself). For this to happen, the premise of such an inference—a general knowledge claim—would have to be treated as indisputably true, which the model

---

37 The focus of this section is the inverse of work on mental logic by Braine and O’Brien (O’Brien, 1998). Whereas their concern is with the logic that underlies our ability to reach knowledgeable conclusions, the concern of the current section is with the ways that conclusions about knowledge are reached as a result of the affordances for deductive and inductive inferences that are intrinsic to a hierarchical network of knowledge claims.

38 An example of such a deductively inferred knowledge claim is as follows: if we assume that it’s true that a child knows how to count, we can deduce that they will correctly count these cookies.
The discursive functioning of knowledge claims in research studies suggests would not be possible. The reason for this is as follows: According to the model, the truth of a given knowledge claim is contingent on the truth of all of its justifications (i.e., the knowledge claim can only be validly asserted if all its justifications can be validly asserted). Yet any given knowledge claim is instantiated by an infinite number of different justifications (i.e., there are an infinite number of different instantiations of the capacity described by a knowledge claim, albeit many of these are only superficially different). It would be impossible to show proof that any person could perform all actions that instantiate a given knowledge claim. Therefore, conclusions about what children know can only be reached inductively, on the basis of observing some subset of all possible performances that instantiate a given knowledge claim.

As an example of this, Sarnecka and Carey (2008) claimed that certain children know that *adding exactly 1 object to a set means moving forward exactly 1 word in the list* [1; 17-18] on the basis of observing children accurately predict the cardinality of a specific set after an item was added. In fact, there are many different actions that could have instantiated this knowledge claim. To assert it on the basis of the observation of only one (or a few) is necessarily to reach an inductive conclusion, according to the model. Of course, if researchers’ goal is to reach conclusions about what children know, there is no realistic alternative to doing this inductively, because it is not possible to observe a child performing every behavior that would instantiate a given knowledge claim, the truth of which would be the precondition for deductively reached conclusions.

Despite the lack of alternatives, researchers’ tendency to make inductive generalizations about children’s behavior is still surprising given the frequency with which previously-asserted knowledge claims were invalidated by subsequently discovered inconsistencies in children’s behavior. These revelations “come with the territory” of inductive inferences, which are not necessarily true, only more of less likely to be true. This begs the question of whether researchers have some basis for determining the probability of accuracy for these statements. The formal model of knowledge claims does not yet contain any basis for making such
The discursive functioning of knowledge claims in research studies estimates of probability. Determining how and why researchers are confident in making inductive generalizations is an important subject for future research.

One possible explanation is that the practice of making inductive conclusions is borrowed from casual, everyday discourse. In these contexts, there are generally constraints on what is at stake with any given utterance, which makes the limits on inductive conclusions irrelevant. For example, the claim that someone knows how to count may have an indefinite number of implications, but when it is uttered in a specific context of a specific activity, few of these may be relevant. This does not hold for scientific investigations, where conclusions are intended to be generally true and universally valid.

Another possibility (not mutually exclusive with the previous one) is that inductive generalizations about knowledge are made on the basis of some experience with the contingencies of human behavior. Through first-hand and second-hand experience with human behavior, individuals may develop some sense of how the performance of one action implies the capability to perform another. Such contingencies undoubtedly exist.

8.5 Described and Actual Capacities

The fact that knowledge claims are used in discourse at all implies that they are useful. This, in turn, implies that there must be some consistency, regularity or patterning to human actions themselves; otherwise generalizations about behavior would be useless. Therefore, we may speak of two parallel, related, but importantly different phenomena: The related varieties of behavior that are described by knowledge claims, and the related varieties of behavior that are achievable by the organism itself by virtue of its structure. In other words, we can distinguish both described and actual capacities for a given organism.

While the current research has shown that knowledge claims are descriptions of capacities, a crucial question is how these described capacities relate to the actual capacities of the organism. Do the descriptions cut along the same lines as organisms’ capabilities tend to? This is another important question for future research.
CHAPTER 9: DISCUSSION

9.1 Generalizability of the Findings to Other Research on Cognitive Development

The current research focused on the topic of children’s number concepts during the preschool years. Strictly speaking, the conclusions of the current research are only generalizable to the discourse from which the analyzed texts were drawn (peer-reviewed, published academic articles about children’s knowledge of number). However, there are good reasons to expect that the main findings—the discovery that knowledge claims are descriptions of behavior, and are justified by more concrete descriptions of some part of the described behavior—are generalizable elsewhere, at least to other areas of cognitive development research on conceptual knowledge. For one thing, despite the narrow focus of the texts the current results were derived from, there is nothing about the results themselves that appears to be limited to numerical knowledge. One limit to the external validity of the current results to other discourses on knowledge are cases in which knowledge is characterized in some form besides knowledge claims. For instance, if researchers are characterizing certain structural features of the nervous system as constituting knowledge (e.g., this might be claimed about Luria’s (1973) functional systems, or certain Piagetian structures (Piaget, 1971)), the current results would not necessarily be applicable. Of course, these cases would only nominally be discourses on knowledge. In all other respects, they would be fundamentally different.

A followup study might check the predictions of the current work on research in other areas. Two good candidates would be research on children’s knowledge of object permanence (Baillargeon, Spelke & Wasserman, 1985), and on children’s theory of mind (Wimmer & Perner, 1983).

Ultimately, it would be interesting to investigate whether the current results generalize to discursive contexts beyond written, peer reviewed/edited, and published research articles. While there is no reason to expect that this would not be the case, these contexts would present challenges not encountered in the study of published research articles. Specifically, while the
The discursive functioning of knowledge claims in research studies

more general audience of a published text leads to otherwise implicit features of a discourse being brought forth, the same is likely untrue in many other discursive contexts, particularly 1-1 interactions. The conclusions reached in the current study would not have been reached if it were not for the comprehensive justification, consideration and explanation of conclusions about knowledge in the analyzed research articles. This comprehensiveness brought forth subtle aspects of the discourse that would have otherwise been invisible.

Aside from their validity, the relevance of the current findings to other discourses focused on knowledge depends on how knowledge is construed in those discourses, and specifically the extent to which it is treated as fundamentally separate from behavior. The importance of the current findings for research on conceptual development in early childhood stems from the fact that researchers investigating that topic have often attempted to go beyond children’s behavior to figure out what they know. This emphasis is founded on and reinforces a semiotic distinction between knowledge and behavior. While undoubtedly useful for certain purposes, this distinction is ultimately an illusion, and causes problems when entire research enterprises attempt to construct scientific knowledge around it.

In general, research on cognitive development of knowledge (or any other discourse that is focused on knowledge) risks incoherence to the extent that it misconstrues the discursive relationship between claims about behavior and claims about knowledge, or attempts to characterize knowledge as ontologically different from behavior. In the context of research on children’s understanding of others, or of object permanence, this is evident in researchers’ privileging of early evidence of competence as proof of knowledge while ignoring or explaining away evidence of (relatively) later incompetence (see Spelke and Kinzler (2007) for examples of this, as well as critiques of this tendency in Allen and Bickhard (2013)). In treating early competence as valid proof of knowledge, and later incompetence is the result of performance demands, the fact that the knowledge in question is simply a description of all of these forms of behavior is lost. These themes are continued in the next section.
9.2 Contribution to the Competence Performance Issue

The findings of the current research have much to add to the existing discourse on the competence-performance issue in psychology. In this section, several prominent ideas in this discourse will be described, and the results of the current study will be used to further develop the ideas in question.

A distinction between competence and performance is undoubtedly a useful one in some contexts, as a result of the combination between variability and indeterminacy that defines human behavior. Simply stated, while it is not possible to precisely predict how a person will act in any given situation, there is sufficient regularity in their action over time to make it possible to make generalizations about their competence, and to distinguish this from their performance in some particular instance. From this formulation, the ontological status of competence—e.g., as a structural cause of behavior, or as the behavior itself—is ambiguous. This issue is dealt with below.

9.2.a Common Positions on the Competence-Performance Issue

The distinction between competence and performance was most famously articulated by Noam Chomsky (1965) around the same time that he published seminal work in cognitive psychology (Chomsky, 1959). Not surprisingly, the distinction has been central to cognitive psychology from its beginning, and has persisted as a central issue in the field for decades.

While an enormous variety of theoretical and empirical work has drawn on this distinction and developed it in various ways, it is possible to distinguish several primary positions that researchers take with respect to it. First, in the work of Chomsky (1965) and similarly inclined researchers (Crain and Thornton, 1998; Gelman & Gallistel, 1978), the competence-performance distinction is used as a way to defend claims about children’s conceptual knowledge in the face of failures to demonstrate this knowledge in their performance. In these arguments children’s failures on tasks are treated as performance errors that reflect processing, memory, or other cognitive demands, whereas their successful
The discursive functioning of knowledge claims in research studies

performances on (typically less demanding tasks) are more valid measures of their competence itself (Baillargeon, Wasserman and Spelke, 1985; Spelke and Kinzler, 2007).

Other researchers use the reverse of this argument to claim that “deficient” performances are themselves a transparent reflection of a more limited competence, and that successful performances elsewhere are the result of imitation, or other rote knowledge, rather than the conceptual knowledge in question. This position is evident in the current research in the Briars and Siegler (1984) article, and has been explained in more depth by Fuson (1988). While these researchers have a different interpretation of performance errors than Chomsky and Gelman (to give two examples), their disagreement reinforces the competence-performance distinction, which is shared by both sides. The shared acceptance of this distinction has led to the development of notions such as procedural knowledge, which has been used as a conceptual tool to differentiate the middle ground between competence and performance (Greeno, Riley and Gelman, 1984; Le Corre, Van de Walle, Brannon and Carey, 2006; Rittle-Johnson, Schneider and Star, 2015).

A different position taken with respect to the competence-performance distinction (or manifestations of it in the context of specific research topics) are denials of the validity of some particular form of competence as an explanatory construct. Such denials take many forms. For example, Chomsky’s (1965) assertion that there is a universal grammar has been contested by a number of different researchers (e.g., Brooks, 2004; Dąbrowska, 2015; Tomasello, 1992, 2003). In some of these arguments, the denial of this one form of competence is replaced by claims about a different competence. For example, Tomasello (1992, 2003) has claimed that children’s interpersonal competence (specifically a capacity for joint attention and intersubjectivity) provides an alternative explanation for the learnability problem of language (the ‘poverty of the stimulus’) that universal grammar attempts to address. An alternative argument (albeit one that is also given by Tomasello) is that the support for language learning that universal grammar purports to provide can be alternately accounted for by the social context in
The discursive functioning of knowledge claims in research studies

which language use occurs. Over the last several decades, this argument has become increasingly common in the literature on language acquisition (Brooks, 2004; Tomasello, 1992, 2003). Wittgenstein makes a similar argument, although rather than arguing that the social context of language use provides adequate support for language acquisition (training in Wittgenstein’s terminology), his private language argument implies that, logically, this is the only way that language acquisition could occur (Williams, 2002; Wittgenstein, 1953).

The emphasis on contextualized action has been developed in the study of complex dynamic systems (Dixon, Holden, Mirman and Stephen, 2012; Kloos and Van Orden, 2009; Stephen and Dixon, 2009; Van Orden, Holden and Turvey, 2003, 2005), also referred to as dynamic systems theory (Thelen and Smith, 1996; Van Geert, 1994). Unlike some of the previously cited literature on universal grammar (e.g., Dąbrowska, 2015), certain researchers in the dynamic systems theory orientation dispute the notion of competence in general (Thelen & Smith, 1996), rather than just in specific cases. The latter’s arguments emphasize the ways that behavioral performances can only be explained by the ongoing dynamics of the organism+context. Invoking some underlying competence, implied to be some entity in the behaving person that is the cause of the observed performance ends up being problematic because of how performance depends so centrally on the constraints of specific situations for its execution (Turvey, Shaw, Reed and Mace, 1981), and can be executed in such an endless variety of ways (Bernstein, 1967). Accounting for flexibly adaptive performances with a notion of underlying competence quickly becomes problematic insofar as unique contexts for performance introduce novel demands that could hardly be accounted for by a competence in the form of some predetermined set of rules.

9.2.b Relevance of the Current Results

The findings of the present study are also interesting to relate to these positions on the competence-performance issue. Some of these positions are more reconcilable with the current findings than others. For example, the current results suggest that debates about whether a
The discursive functioning of knowledge claims in research studies
given behavior provides valid evidence for some competence are misguided when they take
place in scientific investigations. Such debates rely on a separation between the competence
(or the conceptual knowledge) and behavioral performances that has been undermined by the
current research, which showed that the difference between what someone knows and what
they can do is not an ontological one, but instead, just a difference in the degree of abstraction
of the behavior being described, i.e., what someone knows is simply a generalized description
of what they (can) do.

To object to this characterization of knowledge by claiming that that there must be some
underlying (efficient or formal) cause of intelligent action is not wrong in itself. It is of course true
that there must be some cause of any action. Yet, it is problematic to characterize this cause
with a knowledge claim, since this gives a generalized description of behavior as a cause for
some specific instance of that generally described behavior. As was mentioned in the previous
chapter (Chapter 8), the fallacy in this is concealed by the objectification of language and other
figurative devices. While these discursive practices for objectifying knowledge engender the
impression that knowledge is a thing that causes behavior, the results of the current research
corroborated the idea that knowledge claims were descriptions of behavior so consistently, and
in such diverse ways that this more than outweighs any lack of intuitive plausibility.

These ideas are not necessarily inconsistent with the previously mentioned critiques of
the competence-performance distinction, at least in some of its guises, but they do lead to a
different position on the distinction itself. From the perspective of the current results, arguments
about how some or another form of competence doesn’t exist, or that performances are
emergent in a way that renders the notion of competence obsolete, aren’t intrinsically
problematic. Yet they overlook deeper issues with the notions of competence they critique
(admittedly, these issues may not be relevant for certain investigations). These issues are
discussed further in the following section (“Implications of the Model for Cognitive Psychology).
9.2.c Differing Conceptions of Competence

In addition to researchers’ staking out various positions with respect to the competencies that their research participants do/don’t have, another competence-related issue is the way that competence is defined in the first place. Two distinct definitions of competence are evident in the literature. First, some writers give competence a mentalistic construal that is strongly influenced by the computer model for mind/brain processes. This approach was evident in many of the analyzed texts, and in certain seminal publications in cognitive development (Gelman and Gallistel, 1978; Spelke, 2000; Spelke and Kinzler, 2007). In this construal, competence is a set of internalized or mentally encoded rules or principles; it’s a form of mental content or structure that serves as the underlying cause of intelligent action. The other definition treats competence as the highest level of performable behavior. An example of this is described by Fischer, Bullock, Rotenberg, and Raya (1993), who treat competence as a person’s “highest” level of behavior in a particular context. While there are other construals of competence (see the edited volume by Chandler and Chapman (1991) for a comprehensive review), these two are sufficient to illustrate the diversity of the concept in a way that is relevant to the current findings.

The model (i.e., the model developed on the basis of the current study’s findings) readily explains the two previously-mentioned construals of competence. The second construal (in which competence is identified with an individual’s highest level of behavioral performances) is easily accounted for because, according to the model, descriptions of competence (i.e., knowledge claims) are descriptions of behavioral performances. The first construal, which treats competence as some known content that guides performance, is also explicable, albeit in a less obvious way. Insofar as the model treats descriptions of competence as descriptions of behavior, it might be supposed that it would be unable to account for the first construal of competence, i.e., competence-as-knowledge-rather-than-behavior. Yet, as the findings of the text analysis showed, even when knowledge is distinguished from behavior, knowledge claims are still intuitively/normatively linked to certain forms of behavior. These links are difficult to
explain, unless we suppose that knowledge claims are descriptions of behavior. Under this interpretation, the ostensible but illusory distinction between knowledge and behavior is a result of the following: (1) the breadth of the behavioral forms described by many knowledge claims is so wide that the fact that the latter are descriptions of behavior at all is obscured; (2) The reification of knowledge as a (figurative) thing-in-itself; and (3) conflation of the reasons for behavior (which could be descriptions of behavior) with the underlying causes of behavior (which could not conceivably be descriptions of behavior).

9.3 Implications of the Model for Cognitive Psychology

The current model of knowledge claim functioning has significant implications for cognitive psychology. Historically, cognitive psychology is a response to behaviorism and that approach’s restriction of psychological research to observable behavior. Whereas behaviorists sought to explain behavior solely in terms of the contingencies of past behavior without recourse to mentalistic phenomena, cognitive psychology attempts to “go inside the black box” in order to understand the hidden workings of the mind. The need to do this was demonstrated by Chomsky (1959), who showed that behavioral events could not be accounted for in terms of an individual’s history of learning experiences. To get around the limitations of behaviorism, cognitive psychologists sought to infer the hidden underpinnings of observable behavior.

This, of course, is a reasonable goal. The structures and processes that underlie human action are often hidden, and highly complex, and it not surprising if they need to be accounted for in order to explain behavior.

The current results suggest that cognitive psychology has erred in attempting to characterize the hidden workings of the mind with knowledge claims. Knowledge claims do not (at least in the analyzed texts) describe hidden structures/processes/content that underlie observable behavior (i.e., the inner workings of the black box of the mind). Rather, they are generalized descriptions of observable behavior itself.
The discursive functioning of knowledge claims in research studies

The use of knowledge claims to describe the causal underpinnings of observable behavior occurs as a result of the conflation of reasons and causes of behavior, which has been an ongoing problem for psychology (see Appendix 1 for a more in-depth discussion of this issue).

Conflation of the reasons and causes of behavior likely happens for several reasons. One possible culprit is the similarity between discursive scripts describing reasons and causes (e.g., For example, the ball moved because it was hit by another ball; s/he was able to solve the problem because s/he understands addition.). In addition, the objectification of knowledge allows talk about knowledge to be assimilated to scripts or metaphors for objects that imply causal processes (e.g., one object causing another).

The conflation of reasons and causes contributes to theoretical dead ends such as the homunculus fallacy and the symbol-grounding problem, which pose significant threats to large bodies of scientific work (Bickhard & Terveen, 1995). It is also at the root of morally problematic applications of “science,” such as attempts to measure intelligence (Gould, 1981). In the case of the current topic—conceptual knowledge—it has led to the mistaken impression that descriptions of what people know (knowledge claims) are descriptions of the processes that underlie their behavior.

Despite the problems that the conflation of reasons and causes has led to, it is possible to take a more optimistic view, and treat these problems as “growing pains”. In this sense, the conflation of reasons and causes may be understood as an attempt to formulate a causal account of the processes that underlie intelligent behavior using a set of quasi-appropriate tools (knowledge claims). While the use of such tools is problematic, these problems may be addressed, and the corrected set of tools may be useful for explaining the causal basis of behavior.

This kind of conceptual development has been observed in other fields of science. Valsiner (2013) describes how the common concept of salt was incorporated into scientific
The discursive functioning of knowledge claims in research studies

investigations in chemistry. There, the everyday meaning of salt (i.e., salty tasting things) was the historical starting point for the development of an (ultimately very different) concept. Today in chemistry, the concept of salt functions entirely independently of the everyday concept that was its ancestor. A similar development of common/everyday notions might be possible in the case of knowledge.

The work of Mark Bickhard provides an example of how this might be realized. Bickhard (1980, p. 43-63) elaborates a conception of knowledge that is related to, but also fundamentally distinct from the use of the concept in the types of knowledge claim discourse analyzed in this research. According to Bickhard, knowledge is something intrinsic to the interactions of a system (e.g., an organism) in a particular environment. Specifically, knowledge is intrinsic to interactions carried out by a system (living or artificial) whose outcomes are definable within the system itself. The process of knowing refers to the ways in which the control structure of a given system (possibly recursively) anticipates various interaction possibilities.39

Regardless of the utility of Bickhard’s specific formulation of knowledge, it is imperative that cognitive psychology and related parts of mainstream and developmental psychology address the need for conceptual and theoretical clarification. Currently, too much of the scientific work in these fields is spent on problems that are borne out of linguistic and conceptual confusion.

Resolving conceptual issues is a developmental process, and as such, may be

39 An example of this formulation of knowledge can be seen in the case of a person’s interaction with an orange. In this example, the person has knowledge of the orange to the extent that they anticipate various interaction possibilities—and, possibly, the relations between these—with the orange. Described from the standpoint of an external observer, these interaction possibilities include smelling citrus (via the intermediate interaction of bringing the orange to the nose), bringing into view of hidden features of the orange (e.g., the bump where it previously connected to the plant), or peeling off the skin. Some of these interaction possibilities are reversible, whereas others are not. For instance, the orange may be picked up, sniffed, and then returned to the ground to be sniffed later, or interacted with in some other way. Irreversible interactions include peeling off the skin, or eating the orange (the latter would be recursively anticipated via the intermediary interaction of peeling the orange). The process by which these these interaction possibilities and their relations are indicated constitutes knowing, and the control structures that direct these indications constitute knowledge.
The discursive functioning of knowledge claims in research studies

understood in terms of Werner’s (1957) orthogenetic principle: “wherever development occurs it proceeds from a state of relative globality and lack of differentiation to a state of increasing differentiation, articulation, and hierarchic integration” (Werner, 1957, p. 126). In the case of conceptual confusion in science, a useful developmental change would involve the progressive differentiation and organization of conflated concepts. The results of the current project aim to contribute to such a change by showing how issues relating to knowledge can be usefully addressed by examining them in discursive terms. This amounts to the differentiation of a discursive dimension of the concept of knowledge, as distinct from other ways in which the concept might be used (such as that described previously by Bickhard).

In line with Werner’s orthogenetic principle, it is necessary to not only distinguish knowledge (claims) as a part of discourse with knowledge as a property of organisms, but also to hierarchically integrate these differentiated notions to each other. This hierarchical integration is an important precondition for guiding future research efforts related to knowledge with consideration of whether a particular question pertains to the discursive or neuropsychological dimensions of knowledge.
APPENDIX 1: THE DISTINCTION AND CONFLATION BETWEEN REASONS AND CAUSES

The distinction between the reasons and causes of behavior was initially articulated by Wittgenstein (1953) and (slightly later), by Ryle (1949) (publication dates do not reflect the order of development of ideas), and is central to the work of both. The focus is on explanations for behavior in folk-psychological terms, e.g., the phrase he went out to the car because he believed that his keys were there, or she gave the correct change because she knew how to count. With varying degrees of explicitness, both Wittgenstein and Ryle argue that explanations like these cannot be coherently treated as causal accounts. That is, the belief in the first example did not cause the man to go to his car. In the second instance, the woman’s knowledge of counting did not cause her to give the correct change.

Wittgenstein and Ryle both provide related arguments which demonstrate how it is necessary to treat these as reasons, distinct from causes, in order to provide a coherent account of psychological/cognitive processes. Wittgenstein (1953) illustrates this (somewhat implicitly) with the example of a shopkeeper following a simple order:

Now think of the following use of language: I send someone shopping. I hand him a slip marked “five red apples”. He takes the slip to the shopkeeper, who opens the drawer marked “apples”; then he looks up the word “red” in a table and finds a color sample opposite it; then he says the series of cardinal numbers—I assume that he knows them by heart—up to the word “five” and for each number he takes an apple of the same color as the sample out of the drawer.-- --It is in this and similar ways that one operates with words.-- --“But how does he know where and how he is to look up the word ‘red’ and what he is to do with the word ‘five’?”-- --Well I assume that he acts as I have described. Explanations have to come to an end somewhere.—But what is the meaning of the word ‘five’?”—No such thing was in question here, only how the word “five” is used. (Wittgenstein, 1953, p. 3).
The discursive functioning of knowledge claims in research studies

The subsequent questions that Wittgenstein implied and refuses to address are infinite—each one leads directly to the next. They arise (and are infinite) as a result of treating reasons for behavior (articulated in the language of folk psychology) as if they are the causes of behavior. In a causal sequence or chain of events, each successive event is necessarily determined by a preceding set of circumstances, which is itself the outcome of a previous set of events. If we treat reasons for a particular behavior (e.g., a person gave out the right number of items because they know the counting sequence by heart) as if each reason is a successive link in a causal chain that leads up to the performance of a behavior, then a single reason will not provide a full explanation since, as part of a causal chain of events, it must itself be supported by a preceding reason/cause. By rejecting the additional questions about the shopkeepers behavior (and implying the infinite regression that these types of explanations lead to) Wittgenstein is implying that explanations in terms of reasons do not constitute a causal account of behavior, and that there is a meaningful distinction between reasons and causes. Later on, he points to this distinction and its implications more explicitly:

How am I able to obey a rule?"—if this is not a question about causes, then it is about the justification for my following the rule in the way I do. If I have exhausted the justifications I have reached bedrock, and my spade is turned. Then I am inclined to say:

"This is simply what I do. (Wittgenstein, 1953, 217, p. 85).

Ryle (1949) makes a related point in his criticism of the “ghost in the machine” style of thinking that pervades philosophy and psychology. Whereas Wittgenstein emphasizes that explanations (in terms of reasons) normatively come to an end, Ryle emphasizes the problematic infinite regress—Ryle’s regress—that results from the conflation of reasons and causes. In addition, he notes a particularly prevalent case of this type of conflation: the assumption that there must be a hidden mental justification behind every intentional behavior. Ryle describes this line of thinking as resulting from the assumption, typical of the cognitivist approach, that,
The discursive functioning of knowledge claims in research studies

an operation that is characterized as intelligent must be preceded by an intellectual acknowledgement of these rules or criteria; that is, the agent must first go through the internal process of avowing to himself certain propositions about what is to be done (‘maxims’, ‘imperatives’ or ‘regulative propositions’ as they are sometimes called); only then can he execute his performance in accordance with those dictates. He must preach to himself before he can practice. (Ryle, 1949, p. 29)

Historically, cognitivism attempted to go beyond behaviorism by investigating the hidden processes that underlie and mediate behavior. Stated in this way, this is not problematic. It is indisputable that there are hidden processes and structures that underlie people’s observable behavior. The crucial error, identified by Wittgenstein and Ryle, is the assumption that these causal processes can be described in psychological terms. If we characterize the underlying causes of behavior in terms of folk-psychological concepts (e.g., folk-psychological knowledge claims), the goal of explaining behavior is not met, since these explanations posit entities or processes that require precisely the same types of explanation that they were brought in to provide in the first place. For example, if we explain a person’s behavior by claiming that it is guided by knowledge that they possess, we have created something new—the knowledge—that needs to be explained, i.e., how the subject is able to properly bring forth interpret and use the knowledge they are claimed to possess. The problem here is not that the explanation of behavior in terms of knowledge leaves something unexplained, but rather that what it leaves unexplained is not substantially different from what it originally set out to explain. Ryle states this clearly:

the consideration of propositions is itself an operation the execution of which can be more or less intelligent, less or more stupid. But if for any operation to be intelligently executed, a prior theoretical operation had first to be performed and performed intelligently, it would be a logical impossibility for anyone ever to break into the circle. (Ryle, 1949, p. 29)
The discursive functioning of knowledge claims in research studies

Wittgenstein and Ryle both argue that this problematic infinite regress results from reducing folk-psychological concepts to structures or processes in the brain, i.e., reducing the reasons for behavior to its causes. In other words, by conflating causal-mechanical processes with folk-psychological models of the mind, the reasons for behavior (articulated in folk-psychological terms) are treated as if they described the causes of behavior.

Training and the Normative Basis of Social Action

Wittgenstein, having identified the problematic regress that results from causal explanations given in terms of reasons, points to what is, in his view, a more coherent explanation of the causes of behavior. For Wittgenstein, a person is able to behave in the way that they do not because they have knowledge or principles that guide their behavior (since the question of how these knowledge/principles are interpreted would lead to an infinite regress), but instead on the basis of their mastery of a technique, or skilled activity. This notion of a technique cannot be broken down into further psychological language. Acting on the basis of a technique is not acting on the basis of some justified rule. It is in a sense “blind.” Wittgenstein uses the example of following a rule to illustrate the fundamental role of technique, existing prior to all reasons.

"How am I able to obey a rule?"—if this is not a question about causes, then it is about the justification for my following the rule in the way I do.

If I have exhausted the justifications I have reached bedrock, and my spade is turned. Then I am inclined to say: "This is simply what I do." (Wittgenstein, 1953, p. 85)

Later, he says:

"When I obey a rule, I do not choose. I obey the rule blindly." (Wittgenstein, 1953, p. 85)
The discursive functioning of knowledge claims in research studies

This description of the role of techniques in activity is a reversal of the approach seen in cognitive psychology, where action is understood to be guided by underlying knowledge. For Wittgenstein, the basis of action is a technique that cannot be reduced to further propositions, since this would lead to an infinite regress of additional propositions. In a reversal of the cognitivist assumption that knowledge is the prerequisite for action, Wittgenstein argues that rules do not guide the execution of a technique. Rather, it is only in terms of a technique that it is possible to interpret the proper application of a rule. Therefore, the rule presupposes a technique, or it is “only through a technique [that we] can grasp a regularity (Wittgenstein, RFM, VI, 2).

Training and Technique

Wittgenstein’s ideas about the role of technique are explained in terms of a situation in which a novice is trained by a more competent “master” from total ignorance, towards mastery of a technique. In this situation, the master engages the novice in the activity, and provides ongoing feedback—i.e., ostensive training—to guide the learner. Importantly, the feedback is given in the context of the activity itself—the training situation is an apprenticeship.

Through the training, the novice gains the ability to carry out actions typical of the technique, not by virtue of formal rules, or external specifications that account for why certain actions are carried out in a certain way, but only in terms of feedback from the master. With sufficient repetition of the activity accompanied by feedback from a master, the learner comes to master a particular technique. Importantly, it is only through such mastery that any rules governing the proper execution of the technique can be understood. As Williams (2011) writes,

The pattern into which the child is being taught cannot be recognized as such until the child has mastered the techniques for using the rules through the actual repetition of constrained behavior. The child or novice must act out the part if she is to see the pattern. (Williams, 2011, p. 209).
The discursive functioning of knowledge claims in research studies

The word “pattern” that is referred to above pertains to the way that the technique provides a source of regularity. This regularity might be the basis for the interpretation of a rule describing the technique, or for a word, pertaining to some aspect of the technique. It is only through the grounding of the technique that such a pattern can be established.

These regularities are not apparent to the learner during their first initiation into the technique. Nor are they apparent to the master (Williams, 2011, p. 209). Both master and learner are, at the beginning of the training, blind to the technique, but for opposite reasons. For the master, the technique is so ubiquitous that it can be taken for granted and ignored. So for example, an adult counting a set of items does so without any conscious consideration of the reasons for their actions, i.e., for why they counted in such and such a way. They simply carry out the counting activity without attention to these details. For the initiate learner, actions are similarly “reason-less”. Their initial training involves carrying out actions (and being given feedback) without a clear understanding of the rationale for these actions. They fail to see them as conforming to any rule or regularity. That is, in carrying out the actions typical of the exercise of a technique, they are initially unaware of the extent to which their actions constitute valid executions of some rule. Again, it is only through the repetition and feedback typical of training that a basis for interpreting the regularities and rules pertaining to the technique can be gained.

An important implication of this description of the process of training in a technique (which can be applied to a learner’s initiation into any cultural practice) is the fact that the learning process is necessarily a social one. While the learner could develop forms of action to accomplish practical tasks independently of any assistance from others, Wittgenstein’s argument makes clear that any process that involves the use of language (and this includes counting and number use) is founded on a technique that can only be acquired through a social process of training. This is because the techniques themselves are normatively grounded. There is nothing about any particular instance of the execution of the technique that could, by
The discursive functioning of knowledge claims in research studies itself, provide criteria for correctness. Therefore, it is not just a coincidence that the training situation is social, it is fundamentally necessary. The social context provides the only way that a person can develop a sense of “how things are done” that is not carried out on the basis of consciously recognized rules. Since Wittgenstein shows that such rules cannot explain our capacity for action in the first place, the social basis of training is a necessary conclusion.

One important implication of this argument is the idea that normativity—a sense of the rightness or appropriateness of a certain action that is not justified by some prior reason—provides the “bedrock” or foundational guide for our action. In the discursive perspective, normativity is a crucial concept insofar as it describes the characteristic of our active engagement with the world (i.e., its normativity) that explains how we are able to learn to use language to make meaningful distinctions.
APPENDIX 2: ASSESSMENT OF SYSTEMATIC VARIATION IN ADDRESSIVITY

A presupposition of this analysis, and the model is that the functioning of knowledge claims (and language more generally) is dependent on a shared background of forms of life (Wittgenstein, 1953) between interlocutors. It is only with respect to these forms of life that particular uses of utterances—such as a justification given as support for a knowledge claim—can be interpreted as normative, i.e., conventionally appropriate.

Differences in forms of life between interlocutors require things to be made explicit that would otherwise be unstated.40 As this implies, speakers’ (or writers’) utterances are formulated with respect to an intended audience, and what can be anticipated to be normative for them. This influence can be labeled with Bakhtin’s (1986) term addressivity, used here to identify the way that the phrasing of any utterance defines a boundary between what is explicitly stated versus what is left unstated by virtue of interlocutors’ shared participation in a given form of life41.

While addressivity is a constant aspect of language, different instances of language use (e.g., different utterances, the discourses of different communities) differ in terms of what is made explicit versus what is assumed to be understood. As a part of the larger analysis of the selected texts in Study 2, these types of addressivity-related differences were investigated. This sheds insights on the type of discourse or discourses within which knowledge claims are being made. This may address whether, in the analyzed texts, do the assumed understandings constitute only a “local” level of cultural consensus, perhaps restricted to the level of the

40 However, even in these cases, what has been made explicit is still comprehensible only against a background of shared forms of life. A linguistic interaction would not be possible otherwise (see Appendix 1 for an explanation of this point). When otherwise unstated things are made explicit, what changes is merely what is assumed to be understood, i.e., intersubjectively normative. The fact that something is assumed to be understood remains constant, regardless of how much clarification is given.

41 The notion of addressivity goes beyond this. In particular, it also stresses how any utterance is expressed so as to be answerable by the intended audience.
The discursive functioning of knowledge claims in research studies

assumed audience of the journal or even a particular article, or alternately, whether Or, is what
is assumed-as-understood is more general or broad (e.g., what college-educated English-
speaking adults are assumed to understand when reading a research article)? Before
describing the analysis of addressivity-related differences, several considerations relative to this
task are worth noting.

Issues Particular to the Study of Addressivity-Differences in Research Texts

Published research texts present a unique case for the assessment of the issue of
addressivity. The fact that research reports are texts directed at a generalized audience, as well
as the standard of methodological transparency in science, means that many details that will
likely be made explicit in research texts might elsewhere have be treated as assumed-as-
understood. Furthermore, the judgments as to what can be taken for granted as assumed-to-be
understood versus what must be made explicit are not made by a single interlocutor, but by the
combined work of the author and editorial staff. One result of this is that the addressivity that
might have resulted from a single speaker/writer is obscured, as a result of the author’s and
editor’s possibly different assumptions about their assumed audience.

Selection of Texts for “Addressivity-Analysis”

To analyze whether there were systematic differences in addressivity—i.e., assumptions
about the intended audience, pairs of texts from three journals were analyzed. The goal of this
analysis was to identify differences in what is assumed-to-be understood (on behalf of some
intended/perceived audience by the author/editor) versus what is made explicit. The pairs of
texts came from the same, or similarly focused journals. This provided a way to gauge
addressivity-related issues (i.e., patterns in what is assumed-to-be-understood versus made-
explicit) at the level of the journal itself. This was intended to reflect the fact that the analyzed
texts were not utterances directed from a particular contextualized individual to another, but
The discursive functioning of knowledge claims in research studies
rather from one individual towards a certain perceived audience as well as a perceived editorial
staff (with their own assumptions about the audience).

The selected articles included a pair from *Child Development* (Frye, et al., 1989;
Sophian, 1988), a pair from *Cognition* (Davidson et al., 2012; Sarnecka 7 Carey, 2008), and
finally a pair from more educationally-focused journals, *The International Journal of Educational
Research* (Muldoon et al., 2003), and *Educational Studies in Mathematics* (Bruce & Threlfall,
2004). The latter two articles were chosen in order to broaden the range of analyzed articles.
They come from journals focused on educational issues, that were not seen to be cited in the
other contemporary articles from the journal *Cognition*. Nevertheless, the freedom in choosing
an alternative journal (intended as a proxy for an alternative community of interlocutors) was
restricted by the need to find journals publishing similarly themed articles at a similar point in
time (since the lack of topical similarity would have significantly reduced opportunities to
observe differences in addressivity because different topics entail different, and hence, non-
comparable possible assumptions).

**The Challenge of Disentangling Assumed Understandings that Reflect Topical
Differences from Those that Reflect Addressivity Differences**

Identifying systematic variation in what is assumed-as-understood across multiple texts
as these imply different assumptions about the intended audience is a difficult and complex
process, as a result of the fact that different topical foci will result in different things being
assumed-as-understood, not because of differences in the intended audience, but because of
differences in the topic at hand. For example, if I am telling someone about baseball, I would
implicitly assume different things to be understood than if I were telling the same person about
reading. The fact that I didn’t make the same assumptions in both cases is not a function of
assumed differences in the addressed audiences, but rather a function of differences in the
topic at hand. With regards to the current analysis, the focus is on differences in what different
intended audience are assumed to understand with respect to the same issue, rather than
The discursive functioning of knowledge claims in research studies

differences in what is assumed as understood that reflect topical differences only. An example of this type of a difference would be whether, across topically similar utterances about baseball, one utterance assumes understanding of baseball is a sport whereas the other does not, and makes this explicit.

Unfortunately, the distinction between addressivity issues related to different assumed audiences versus those related to topical differences is not so clear cut. Addressivity issues reflecting topical differences and those reflecting differences in the assumed audience are frequently conflated with one another and impossible to disentangle. This can be illustrated with an example from Gelman who writes, “the child clearly possesses a logical system for manipulating number before he reaches the stage of concrete operations.” (1972, p. 89).

Elsewhere in the text, there is a description of Piaget’s conservation task, which is portrayed as a measure of whether the child treats number as invariant, which is in turn portrayed as (at least according to Piaget) indicative of the child’s number concept. Despite this, “concrete operations” is not brought up, or shown in any way to be linked to the conservation task, or to Piaget. This quote therefore, is assuming that the audience understands that “concrete operations” are related to performance on the conservation task.

This example reveals problems with the previous distinction between addressivity issues related to different assumed audiences versus those related to topical differences. On one hand, none of the other articles assumed knowledge of concrete operations (even if they mentioned invariance), and many of them didn’t even bring up this issue (Briars and Siegler, 1984; Brooks, Audet & Barner, 2012; Davidson, Eng & Barner, 2012; Frye, et al., 1989; Gelman & Meck, 1983; Sarnecka & Carey, 2008; Wynn, 1990). On one hand, this could be attributed to the fact that these articles had a different topical focus than Gelman (1972). The Gelman text was uniquely focused on children’s understanding of the invariance of number words in a way that the others were not, and in a way that is arguably more related to Piaget’s claims. Yet, these differences in topic are not a mere matter of coincidence. They reflect changes in the
The discursive functioning of knowledge claims in research studies

historical orientation of the field of research, and the presence or absence of certain ideas. Therefore, while Gelman’s mention of Piaget and her assumption of the audience’s understanding of Piagetian research could be attributed to her topical focus (rather than differences in who the assumed audience will be), the choice of that topical focus is clearly linked to a certain historical period—a historical period in which some things and not others were understood and assumed as understood. Therefore, while the mention of “concrete operations” in the Gelman text is clearly related to addressivity, it does not clearly show a pronounced difference in assumptions about the intended audience, but rather addressivity-related issues that are bound up and conflated with historical ones, via the choice of topic.

**Strategic Basis for Justification/non-justification of Knowledge Claims**

Another interesting case of entanglement between the topical focus of an article and issues of addressivity is seen in cases where the lack of justification given to particular knowledge claims appears to be related to whether or not those claims are being advanced, contested, or are irrelevant to the overall arguments made in the text. One case of this is seen in the Brooks et al. (2012) article, which attempts to provide an alternative explanation for findings reported by Sarnecka and Gelman (2004). In introducing their study, Brooks et al. assert several knowledge claims but do not provide justifications (besides citations) for them. The lack of justification in this case may be best interpreted as reflecting the author’s understanding of their position within a particular academic discourse. The unjustified claims are not those that they themselves are ultimately asserting, but instead claims they later contest. The lack of initial justification\(^{42}\) may therefore reflect the authors’ assumption that any perceived (by the audience) need for justification will be more than rectified by the subsequent focus no, and ultimate contestation of the claims.

\(^{42}\) Insofar as the lack of justification might suggest that Brooks et al. (2012) were attacking a straw man, it is worth noting that the claims were later justified.
A similar case is found in Briars and Siegler (1984), who make several claims about children’s knowledge early on in their article that have no justification (with this being said, the claims are general). However, the strategy that the author’s appeared to be using in doing this is likely similar to what was seen in Brooks et al. In both cases, the author’s ability to make a claim without justification is likely premised on the fact that the overall arguments in their text are orthogonal, i.e., contrary, to these claims.

**Possible Solution**

Although addressivity-related issues can and will show up in any use of language, the identification of systematic differences in assumptions related to addressivity across texts corresponding to assumed differences in the intended audience can only be done with regards to something that is found across all of the texts. To the extent that addressivity is identified with features that are not common across texts, it is not possible to claim that it represents a difference in what the author assumes the audience understands (implying a distinct audience), as opposed to a specific assumption that was implied in one text but not another because of the nature of the topic. It is only in cases where there are differences in what is assumed versus what is explicit across texts, with regards to the same knowledge claim (or other statement), that there are grounds for conclusions about addressivity.

Therefore, it is necessary to focus on specific claims that are found throughout all texts to allow for comparison. The current analysis ultimately focused on claims that were common in the analyzed texts—*understanding counting*, and/or *understanding/knowing how to count* (the differences between these were acknowledged and not treated as irrelevant), as well as claims about *counting* by itself (e.g., *the child counted, the child could count to four*).

The use of each of these knowledge claims was analyzed in the selected pairs of texts. The analysis identified where the claims were first made in the text (both asserted or considered claims were included), any qualification, description, or explanation for what a particular claim meant was recorded in the form of quotes. The analysis was intended to identify cross-journal
The discursive functioning of knowledge claims in research studies
differences in the manner and extent to which the introduction of a claim in particular texts
involved explanation and extended description, intended to clarify what was meant. These
differences would imply different assumed audiences.

Results by Claim
The analysis was focused on two things. First, the extent to which a given knowledge claim was
treated as if it had the same or different implications. Secondly, the issue of whether these
different implications were explicitly noted or not. These findings are discussed first for the claim
understanding [how to] count[ing], and then secondly for counting itself.

Understanding Counting/Understanding How to Count
This claim was found to be used in four distinct ways, i.e., to have four distinct implications.
These different uses were found in some articles but not others:

- As a way to distinguish a roughly bounded collection of various forms of counting
  knowledge, rather than knowledge of a single discrete thing. For instance, Sophian
  (1988) writes that “These [counting] principles are thought to reflect knowledge that is
  implicit in children’s counting and other action schemas.” [1R]. These uses were also
  found in Frye et al (1989).

- As shorthand for CP-knowing. This was seen only in articles by Davidson et al. (2012)
  and Sarnecka & Carey (2008). In these articles several cases of the claim that “children
  who understand counting” were observed which clearly referred to children who could
  create sets of any requested number of items (i.e., children who were identified as CP-
  knowers). In each of these articles, this use of “understanding counting” was explicitly
  clarified, suggesting the assumption that this would not be the audience’s default
  interpretation.

- As a way to refer to an understanding of the logical significance of counting, the meaning
  of counting, or conceptual knowledge of counting. This is a more general case of the
previous use of “understanding counting.” Rather than referring to CP-knowing, it was used to distinguish something general—i.e., anything other than “procedural knowledge” (the specific distinction was determined by the context)A clear example of this is seen in the Davidson et al. (2012) text: “If a semantic induction occurs sometime after children become CP-knowers (by Wynn’s criteria) then children’s understanding of counting could, in theory, rely on a mapping to the ANS.” [24], which in the context of the text, is clearly intended to refer to something more than procedural knowledge.

- As a broad conclusion made on the basis of children’s across-the-board performance on various counting tasks. This usage was seen in Sarnecka & Carey (2008), as well as in Davidson et al. (2012). In those articles, the implication of this meaning is either explicitly stated, or implied by the conditions on the claim’s use. An example of the former is seen in the following quote from Sarnecka & Carey (2008): “Cardinal-principle-knowers succeed across the board on these tasks. Such qualitative differences in the counting behavior of subset-knowers and cardinal-principle-knowers suggest that what ultimately separates the groups is not just the size of the sets they can generate. Rather, it is that cardinal-principle-knowers understand how counting works, whereas subset-knowers do not.” [5]

What can be made of these different uses? Notably, the different implications of the claims do correlate somewhat to different journals (and eras). While this may imply different uses of the claims predominating at different contexts, it does not necessarily imply a difference in addressivity. As far as the issue of addressivity is concerned, the crucial difference is whether specific differences in the use and implications of claims are explicitly marked, or introduced with the assumption that they will be understood in a particular way, without this being made explicit. A close analysis of these different uses of knowing how to count/understanding counting provides little reason to think that the uses of this claim in different ways without
The discursive functioning of knowledge claims in research studies

explicit mention of this fact, indicated the assumption of a different audience. There are several reasons for this conclusion.

**Some of these differences were superficial.** Several of the apparent differences above were largely superficial. For example, the first and the fourth uses are not fundamentally distinct. Both involve the shared assumption that *understanding how counting works* is a highly generalized knowledge claim about using counting in normative ways across many different contexts. The difference between them has to do with the first not being an assertion of knowledge, but instead the use of the knowledge claim to draw a very general distinction (corresponding to the generality of the claim itself) about a particular set of knowledge claims. The fourth use involves the assertion of the claim on the basis of a stated variety of concurrently observed behaviors.

**Some uses were explicitly marked.** The second use of *understanding counting* involved a somewhat unique meaning. However, there is little evidence that this meaning was assumed as understood for the audience. In every article where *understanding counting* was used to refer to CP-knowing, this was explicitly stated. In fact, in the articles that ultimately ended up asserting this claim (i.e., usage), extensive explanation was given for support (whereas in the Davidson et al. article where this usage was disputed, somewhat less, but still explicit explanation was given to account for why being a CP-knower would ostensibly imply that a child *understands counting*. The fact that this specialized meaning of *understanding counting* was made explicit indicates that it was not assumed as understood.

**Implicit contextual cues in the absence of explicit explanation of meanings.** Some instances in which *understanding counting* was used in particular ways (specifically, the third usage) did not involve explication that this was the case. However, in these cases, it was not possible to conclude that this reflected assumed understandings by the author/editor about the audience. Despite the absence of explication about the meaning of *understanding counting*, the use of this term in context (of the text) provided cues to demarcate its meaning to the extent that
The discursive functioning of knowledge claims in research studies

there was no indication of an audience that was more specialized than that assumed by the other texts. As an example of how these contextual cues functioned, consider how the claim that a child understands how to count could have different implications depending on whether it is used in the text to draw a contrast with understanding the conceptual significance of counting versus being used in contrast with being able to recite the count list. A clear example of how the same claim used with different meanings in the absence of explicit indications of these meanings does not necessarily implicate different assumed audiences can be shown with the following example, which concerns children who have learned how to count.

Different meanings of the same knowledge claim: The case of ‘learning to count’. An example of the same claim used with different implications in the absence of any explicit mention of this is seen with the claim of learning to count sets (although this phrasing suggests a change over time, this was used as a knowledge claim description of a capacity at one point in time, essentially the same way that knowing how to count sets might be used).

Learning to count is used by Davidson et al (2012) to describe children who have passed the Give-N task. This use of learning to count appears throughout the text (including in the title) and is evident in the quotes such as the following, from the introduction,

By some accounts, children must make a semantic induction in acquisition, at which point they generalize the above number knowledge to all numerals they have learned, and to all numbers that they will ever learn (Samecka & Carey, 2008; Wynn, 1990, 1992). Often, this inductive leap is said to occur when children become so called “cardinal principle knowers”, at around the age of 3 and a half. Here, we examine the empirical basis for this hypothesis and whether learning to count involves a semantic induction.

In the early stages of acquisition, children’s knowledge of numerals is limited and is mainly procedural in nature. Before they learn any numeral meanings, children first
learn to recite the words in a list (e.g., “one, two, three...”). As part of this procedure, they learn that numerals are always recited in the same order (i.e., the stable order principle) and that each numeral should be said when pointing to a different item (i.e., the one-to-one principle; Gelman & Gallistel, 1978). Sometime after 2 years of age, children begin to acquire meanings for words in their count list, beginning with one: “one-knowers” can give one object when asked, and can correctly label a set as one. However, although these children can recite higher numbers (e.g., 5 or 10), and know that these higher words contrast in meaning (Condry & Spelke, 2008; Wynn, 1992), they appear to lack meanings for the rest of the words in their count list (Wynn, 1990, 1992, etc.). After this one-knowers stage, children become “two-knowers”, and are able to distinguish one and two from each other and from the rest of the numbers in their count list. Next they learn three, (three-knowers) and then (sometimes) four (four-knowers). At each of these stages children are known as “subset-knowers” since they have exact meanings for only a subset of the words in their count list. Finally, sometime between the ages of 3-and-a-half and 4, children discover that counting can be used to generate sets of the correct size for any word in their count list. These children are referred to as cardinal principle knowers (CP-knowers), since they appear to understand how counting represents cardinalities. [3-4]

In the Davidson et al. (2012) text, the citations, the way particular tasks are used, and the overall logic of the experiment implies that learning to count is used here specifically to indicate children passing the Give-N task. However, in other texts, the same or similar knowledge claims are used by researchers to describe a more basic “procedural” knowledge of counting, rather than passing the Give-N task (in fact, this usage implies children who do not pass the Give-N task). An example of such a clearly different usage is seen with Nikoloska (2009), who uses
The discursive functioning of knowledge claims in research studies

"learning to count" to describe children’s procedural knowledge of counting prior to becoming CP-knowers:

“Considering all presented studies it appears that children first learn how to count and only later they grasp the principles that guide the counting. No matter how easy the task children younger than about the age of 3;6 are presented with, they fail to demonstrate understanding of the cardinal principle, and without understanding this principle they have not mastered the concept of counting.” [6]

Citations elsewhere in the Nikoloska article make very clear that “grasping the principles that guide counting” or “demonstrating understanding of the cardinal principle”--the two achievements that are contrasted with “learning to count, refer to children’s successful performance on the Give-N task. Consequently, when taken in conjunction with the previous example from Davidson et al., we find the same knowledge claim being used in exactly opposite ways.

To the extent that these different uses of the knowledge claim are intended to be interpreted as described here, this reflects a difference in what the author/editor assumes the audience understands. However, this doesn’t mean that the authors are assuming two audiences who are distinct from the outset, prior to reading the text. It is at least as plausible that the author’s assumed similar audiences, whose initial (non-rigid or potentially flexible) assumptions about learning to count have been transformed by the broader network of discursive distinctions made within each text. In relation to the network of distinctions within each text, the same knowledge claim could come to have opposing meanings for essentially similar audiences. What is most striking is that, although the differences in meaning of learning to count result from differences in how this phrase is used in each text, the possibility of reaching the differing meanings is dependent on the same background assumptions: In both
The discursive functioning of knowledge claims in research studies
texts, the opposing meanings are reached as a result of the audience’s assumptions about the
Give-N task as a measure of counting knowledge.

Implications of the Analysis So Far

The analysis so far has shown the task of assessing differences in addressivity to be a particularly difficult one. Although understanding counting has been used in different ways across different texts, there has so far been no indication that these differences reflect different assumed audiences. Even if particular ways of using the claim differ systematically with different journals, these differences have so far been more parsimoniously explained in terms of the differences in topical orientation, and in terms of how the semantic flexibility of the claims allows them to be constructed differently from one text to the other.

While the analysis so far suggests that the background understandings of the assumed audience, vis a vis knowledge claims, are similar across the analyzed articles, one objection to this conclusion is that the knowledge claim in question (understanding counting) was fairly broad or generalized. This could have accounted for why, although it was sometimes taken to mean different things, these different meanings were not expected outright (by the author), but constructed (possibly implicitly) through the pattern of distinctions making up the text. It is possible that differences would become apparent if a more concrete claim were analyzed, one that is less semantically broad. To consider this possibility, the next section describes an analysis of a much more concrete knowledge claim--the claim that a child has counted.

Counting

In considering the use of counting, we are interested in whether counting is assumed to have some already-understood meaning, or whether it is explicitly described. Do the texts merely refer to counting as if it demarcates a clearly understood activity, or do they use this term only with qualification? To investigate counting, a similar approach to that used in the previous
The discursive functioning of knowledge claims in research studies

eexample was used—i.e., instances of counting were identified, with attention given to whether this term was presented as an understood “given”, or whether it was qualified or defined explicitly. However, this time, to facilitate understanding of addressivity related differences across not just articles, but publications (reflecting the assumption that the publication itself might assume a particular audience), the analysis of counting was carried out on two articles from Child Development (published 1988, 1989), two articles from Cognition (2008, 2012), and two additional articles from more education-oriented journals, The International Journal of Educational Research (Muldoon et al., 2003), and Educational Studies in Mathematics (Bruce & Threlfall, 2004).

Although these articles differed in focus, they all involved counting, and that word was used repeatedly throughout the text. When comparing across texts, as well as across journals, there appeared to be very consistent assumptions about what is assumed-as-understood regarding counting, and which types of things must be made explicit. Overall, and in every article, counting was introduced and initially used without explicit description of what this activity entailed, except in cases where counting was either qualified, or talked about within some broader context that necessitated explanation. Explanation of what was meant by counting in general was only found in parts of texts dealing with methodological details. It is reasonable to conclude that these added descriptions are given in the service of ensuring methodological rigor, rather than to address some anticipated confusion about what is meant by counting more generally.

Although, as the previous paragraph implies, the knowledge claim counting (e.g., the child counted) was not generally given further specification or explanation, a more thorough investigation of the texts revealed that nearly every use of “counting” by itself (i.e., not as a part of a wider phrase such as knowing how to count, or counting principles) was intended to refer to the general act of reciting the number words, often accompanied by sequential pointing to objects. In almost every case, counting was used indiscriminately to refer to performances of
The discursive functioning of knowledge claims in research studies

correct or incorrect counting, and counting carried out regardless of the counter’s understanding of what they were doing.

The introduction of counting without further specification of what this implies is exemplified in the following quote from Muldoon et al. (2003).

A number of recent studies have identified predictors of mathematical development among children between 5 and 11 years, and a picture is emerging of the components and relationships integral to this development in school (see, e.g., Geary, 1994; Geary, Bow–Thomas, & Yao, 1992; Shayer, this issue). The same claim cannot be made about the relationship between earlier numeracy (also called mathematical literacy or number sense in the USA), around the age of 4, and children’s first experiences of more formal teaching. In this paper we focus on one of the most important skills children develop before they begin school, and one they typically take with them to the classroom; the ability to count.

Children’s understanding of counting is important because of the crucial role it plays in the construction of mathematical knowledge (Frydman, 1995). Indeed, the knowledge they have about the number system before starting school is a strong predictor of attainment at the age of 7 (Tizard, Blatchford, Burke, Farquhar, & Plewis, 1988). Early procedural mastery of counting suggests that children have a firm foundation for later developments in arithmetical understanding. However, it is one thing to be able to count, but it is another thing to know how counting and quantity are related. Young children often have difficulty in extending their counting skills to questions other than ‘How many?’ (Frye, Braisby, Lowe, Maroudas, & Nicholls, 1989). Hughes (1986) has argued that some early numerical achievements are founded on procedures and not genuine insight. This is a potential problem for teachers who expect otherwise-proficient counters to recognise what counting achieves and to use it
The discursive functioning of knowledge claims in research studies

appropriately to solve simple number problems. This begs the question of how children gain this conceptual insight. (Muldoon, et al, 2003, p. 696)

In the above quote, counting is introduced (“the ability to count”), and then the discussion moves on to the understanding of counting, its importance, and finally the distinction between procedural mastery of counting. The notion of procedural mastery is then used to structure the distinction between being able to count and knowing how counting and quantity are related. Throughout the rest of the article, there is clarification of what it means to know how counting and cardinality are related (some of which is seen in the sentence following the introduction of this distinction, above). However, the idea that counting, by itself, refers to some kind of procedural knowledge or recitation activity is only given implicitly.

**Implications and an Alternative Approach**

The analysis of what is assumed versus explicit found clear commonalities in uses of understanding counting and counting across different texts. The identification of addressivity-related differences in the implications of a given knowledge claim across texts from different journals turned out to be difficult to achieve. Differences in the uses of these claims tended to be (1) explicitly marked (e.g., by ‘understanding counting’, we mean that a child has passed the Give-N task) or (2) implicitly constructed in relation to other distinctions in the text (see the example of learning how to count, above). While there are certainly differences in what author’s/editors of the analyzed texts assumed their audiences understood, these were not apparent in this analysis, which suggests stability/homogeneity in the analyzed discourse.

The lack of systematic cross-text (and across types of texts) differences in addressivity or in what is normative is partly a reflection of the dynamic nature of addressivity. While it is possible to make approximate generalizations about the boundary between what is explicit and what is unstated, this boundary is fundamentally dynamic and emergent; constantly defined by
The discursive functioning of knowledge claims in research studies

the boundary between what is explicitly said, and what is not, but could have been said. Over
the course of the expression of an utterance, what is left unstated is a function of who the
audience is assumed to be, not just in general, but also at that moment in the course of the text
(i.e., they are assumed to be the audience who is familiar with the preceding parts of the text).
In other words, the audience is assumed to be continually changing over the course of the text.
With every additional statement, they are transformed. Every statement makes something new
explicit, which can then become a part of the just-stated background against which the next
statement rests.

Aspects of Addressivity-related Assumptions

Although systematic differences in addressivity were not found in this analysis, it is possible to
say several things about the general role of addressivity in the discursive functioning of
knowledge claims. Addressivity-related assumptions that relate to the use of knowledge claims
can be grouped into two categories:

1. assumptions about an audience’s interpretive abilities (i.e., the way and the extent to
   which something will have to be described in order to be understood as intended)
2. assumptions about the audience’s willingness to accept an asserted knowledge claim as
   true

The first type of assumption is clearly evident in Type 2b explanations, among other places.
These explanations functioned to establish a connection between a knowledge claim and a
justification that, it is assumed, would not have otherwise been self-evident for the audience. For
example, it might be assumed that without the 2b explanation, it would not be apparent to the
audience that a given knowledge claim is a generalization that encompasses certain more
concrete claims, and is itself more concrete with respect to more generalized knowledge claims.

The first kind of addressivity-related assumptions were by no means only found in Type
2b explanations. Assumptions about how thorough of a description will be sufficient for audience
comprehension also affect the extent to which knowledge claims/justifications/explanations were described more or less fully in the text. While the extent to which knowledge claims are described more or less thoroughly does indicate assumptions about the assumed audience, these are not assumptions about the particular person in general who will be reading the text (outside of any particular activity setting), but rather, expectations about that person in relation to a certain genre of text. In scientific research articles, the extent of description is a reflection of the cultural value of “rigorous” reporting of scientific results, which leads the writers of research articles to make certain details explicit on the assumption that they may be relevant objects of unforeseen forms of scrutiny (or on the assumption that more detailed reporting will shield them from scrutiny of being “unscientific”).

The second kind of addressivity-related assumption involves the asserted knowledge claims that the assumed audience is seen as willing/unwilling to accept without further justification, and in the latter case, the type and extent of additional justification they are assumed to require. These assumptions may lead an author to assert a knowledge claim without providing further justification (including citations).

Like the first kind of assumption, addressivity-related assumptions of this second type involve the assumed audience in relation to the particular text (as it embodies a particular genre, makes particular arguments etc.). So, assumptions about the assertions they are likely to accept uncritically are based on assumptions about them in the context of their act of reading the particular text at hand. The same person may be assumed to be willing to accept a particular assertion in one text but not another, depending on the broader text and context. Examples of this were found in several texts, such as the following case from Briars and Siegler (1984).

Briars and Siegler report, near the beginning of their article, that “young children clearly possess considerable knowledge of counting” [1R; 42]. Although further claims are given later on that may implicitly justify this claim, the claim itself is not immediately justified, despite being a claim that might, by the standards of other texts on this general topic, be given a
The discursive functioning of knowledge claims in research studies

justification. Instead, it is asserted as if under the assumption that the anticipated audience would not find it problematic. This must be considered in light of the overall claims made in the text. Briars’ and Siegler’s overall argument is that children’s knowledge of counting is less extensive than had been claimed by those they cite most frequently, and whose work the study they describe responds to: Gelman and Meck (1983). Given this orientation in the overall text, the claim that children have considerable knowledge of counting may have been asserted without justification on the basis that it opposes the general orientation of the other claims in the text, and aligns with those made by critical members of the audience, and is not a statement that is being asserted as a scientific conclusion.

**Locating Addressivity in the Model of Knowledge Claims**

*Assumptions About What is Assumed-to-be Understood.* The place of addressivity in the model of knowledge claim functioning can be further explained in terms of features of the analyzed texts themselves, in which addressivity-related assumptions—can be located as structural-relational characteristics in language use.

The model characterizes what is assumed to be understood in a counterintuitive way. Intuitively, we may say that we express utterances that we assume will be understood by our audience. The model conceptualizes this issue differently. In the model, what is assumed as understood is precisely what is not stated, and it is not stated because it is assumed that it is already understood. Conversely, what is not assumed to be understood is precisely what is stated. This is meant in the most literal sense, i.e., the only thing that is not assumed to be understood is the spoken sequence of words comprising a stated claim. The meaning of this statement (unless it is further clarified) is assumed to be understood.
APPENDIX 3: EXAMPLE OF A TYPE 1 EXPLANATION PREMISED ON THE PRESENCE OF CONCURRENT VALIDITY

Sarnecka and Carey’s (2008) claim that children who pass the Give-N task (i.e., cp-knowers) understand how counting works involves a Type 1 explanation premised on concurrent validity between passing the Give-N task, and performance on various other counting tasks. Their argument is quoted below:

Within-child consistency on a wide variety of tasks suggests that cardinal-principle-knowers differ qualitatively from subset-knowers. Most conspicuously, subset-knowers do not use counting to solve the Give-N task (even if they are explicitly told to count), whereas cardinal-principle-knowers do use counting – an observation that led Wynn, 1990 and Wynn, 1992 to call subset-knowers “grabbers,” and cardinal-principle-knowers “counters”. But the differences do not end there. For example, a “two”-knower is, by definition, unable to give three objects when asked for “three.” But a “two”-knower is also

(a) unable to fix a set when told, for example, “Can you count and make sure you gave the puppet three toys?... But the puppet wanted three – Can you fix it so there are three?” (Le Corre et al., 2006);

(b) unsure whether a puppet who has counted out seven items has produced a set of “seven” (Le Corre et al., 2006);

(c) unable to point to the card with “three” apples, given a choice between a card with three and a card with four (Wynn, 1992); and
The discursive functioning of knowledge claims in research studies

(d) unable to produce the numeral “three” to label a picture of three items (Le Corre et al., 2006).

Cardinal-principle-knowers succeed across the board on these tasks. Such qualitative differences in the counting behavior of subset-knowers and cardinal-principle-knowers suggest that what ultimately separates the groups is not just the size of the sets they can generate. Rather, it is that cardinal-principle-knowers understand how counting works, whereas subset-knowers do not. [4-5; 5-32 (from 4; 9 to 5; 32)]
The discursive functioning of knowledge claims in research studies

APPENDIX 4: INTRODUCTION OF SARNECKA AND CAREY (2008) TEXT WITH HIGHLIGHTED KNOWLEDGE CLAIMS AND UNDERLINED JUSTIFICATIONS

The following is a segment of the first several pages of the Sarnecka and Carey (2008) text in which knowledge claims, justifications, and explanations (Type 1 only) have been marked. Knowledge claims are highlighted in green, justifications are underlined (and in green), and explanations are indicated by bold typeface.

Abstract

This study compared 2- to 4-year-olds who understand how counting works (cardinal-principle-knowers) to those who do not (subset-knowers), in order to better characterize the knowledge itself. New results are that (1) Many children answer the question “how many” with the last word used in counting, despite not understanding how counting works; (2) Only children who have mastered the cardinal principle, or are just short of doing so, understand that adding objects to a set means moving forward in the numeral list whereas subtracting objects mean going backward; and finally (3) Only cardinal-principle-knowers understand that adding exactly 1 object to a set means moving forward exactly 1 word in the list, whereas subset-knowers do not understand the unit of change.

1. Introduction

It seems uncontroversial to say that some children know how to count and others do not. But how can we tell them apart? If knowing how to count just means reciting the numeral list (i.e., “one, two, three...”) up to “five” or “ten,” perhaps pointing to one object with each numeral, then many two-year-olds count very well (Baroody and Price, 1983, Briars and Siegler, 1984, Fuson, 1988, Fuson et al., 1982, Gelman and Gallistel, 1978, Miller and Stigler, 1987 and Schaeffer et al., 1974). That kind of counting is good for marking time (e.g., close your eyes and count to ten...) or for playing with one’s parents, but reciting the alphabet or playing patty-cake would do just as well. The thing that makes counting different from the alphabet or patty-cake is that counting tells you the number of things in a set.

Of course, counting only tells you this if you do it correctly, following the three ‘how-to-count’ principles identified by Gelman and Gallistel (1978). These are (1) The one-to-one principle, which says that “in enumerating a set, one and only one [numeral] must be assigned to each item in the set.” (p. 90); (2) The stable-order principle, which says that “[Numerals] used in counting must be used in the same order in any one count as in any other count.” (p. 94); and (3) The cardinal principle, which says that “the [numeral] applied to the final item in the set represents the number of items in the set.” (p. 80).
As Gelman and Gallistel pointed out, so long as the child's counting obeys these three principles, the numeral list ("one," "two," "three,"... etc.) represents the cardinalities 1, 2, 3,... etc. The relation of numerals to cardinalities is governed by the successor function: If numeral "N" represents cardinality N, then the next numeral on the list represents the cardinality N + 1, which is the successor of N. The counting principles are what make counting equivalent to saying "one, (plus one is) two, (plus one is) three,...”

In their 1978 book, Gelman and Gallistel argued that even 2-year-olds honor [the counting] principles when counting, because [the principles are intuitively understood. This view has come to be called the principles-first (or principles-before-skills) view.

Other studies, however, have failed to provide support for the principles-first view. For example, three-year-old children often violate the one-to-one principle by skipping or double-counting items, or by using the same numeral twice in a count (Baroody and Price, 1983, Briars and Siegler, 1984, Frye et al., 1989, Fuson, 1988, Miller et al., 1995, Schaeffer et al., 1974 and Wagner and Walters, 1982). Children also violate the stable-order principle, by producing different numeral lists at different times (Baroody and Price, 1983, Frye et al., 1989, Fuson et al., 1983, Fuson et al., 1982, Miller et al., 1995 and Wagner and Walters, 1982). These findings have led many observers to conclude that the how-to-count principles, rather than being understood from the outset, are in fact gradually learned. This is known as the principles-after (or skills-before-principles) view.

Of course, as Greeno, Riley, and Gelman (1984) point out, children might have trouble pointing to objects and reciting the list even if they do understand how counting represents number. Much more troubling for the principles-first view is evidence that young children do not understand the cardinal principle. That is, children do not seem to recognize that the last numeral used in counting tells the number of items in the set. One type of evidence comes from How-Many tasks. The version used by Schaeffer et al. (1974) is typical:

“Each child was asked to count the chips in a line of x poker chips, where x varied between 1 and 7. After the child had counted the chips, the line was immediately covered with a piece of cardboard and the child was asked how many chips were hidden. Evidence that he knew... [the cardinal principle] was that he could respond by naming the last [numeral] he had just counted.” (p. 360)

Some investigators have argued that the How-Many task overestimates children's knowledge, because some children actually do repeat the last numeral used in counting without (apparently) understanding that it refers to the cardinal value of the set (Frye et al., 1989 and Fuson, 1988).

Conversely, it has been claimed that the How-Many task underestimates children's knowledge (Gelman, 1993 and Greeno et al., 1984), because many children respond incorrectly to the question “how many,” even after they have counted the array correctly. Rather than answering with the last numeral of their count, children who are asked “how many” usually try to count the set again. If they are prevented from recounting, they either make no response or give some numeral other than the last numeral of their count (Frye et al., 1989, Fuson, 1992, Markman, 1979, Rittle-Johnson and Siegler, 1998, Schaeffer et al., 1974, Wynn, 1990 and Wynn, 1992).
Supporters of the principles-first position argue that such behavior generally demonstrates that children do understand the cardinal principle. They point out that it is pragmatically strange to ask “how many” immediately after counting (Gelman, 1993 and Greeno et al., 1984). To demonstrate this point, Gelman (1993) did a How-Many task with college students: “When we asked undergraduates a how-many question about 18 blocks, all of them counted but only one bothered to repeat the last count word said. Repeats of the question elicited puzzlement, some recounting, and so forth... “ (p. 80).

In short, people disagree about whether the How-Many task underestimates, overestimates, or accurately measures children’s knowledge of the cardinal principle. This raises other questions – namely, if the How-Many task doesn’t test understanding of the cardinal principle, what does it test? And conversely, if cardinal-principle knowledge cannot be tested by the How-Many task, then how can this knowledge be tested?

1.1. The Give-N task

The Give-N task provides a different way of measuring cardinal-principle knowledge. In this task, the child is asked to create a set with a particular number of items. For example, the experimenter might ask the child to “Give two lemons” to a puppet. Studies using this task have found that children are often unable to create sets for numerals that are well within their counting range. For example, many children who can count to “five” are not able to create sets of five objects. Thus, if cardinal-principle knowledge is tested using the Give-N task (rather than the How-Many task) children appear to acquire the cardinal principle relatively late, and only after mastering the other two counting principles.

Give-N studies have also yielded a new picture of how numerals are learned. It turns out that a child’s performance on the Give-N task goes through a series of predictable levels, first reported in a longitudinal study by Wynn (1992) and supported by many cross-sectional studies since (Condry and Spelke, 2008, Le Corre and Carey, 2007, Le Corre et al., 2006, Sarnecka and Gelman, 2004, Sarnecka et al., 2007, Schaeffer et al., 1974 and Wynn, 1990). These performance levels are found not only in child speakers of English, but also for Japanese ( Sarnecka et al., 2007) Mandarin Chinese ( Le Corre et al., 2003 and Li et al., 2003) and Russian speakers (Sarnecka et al., 2007).

The developmental pattern is as follows. At the earliest level, the child makes no distinctions among the meanings of different numerals. On the Give-N task, she may always give one object to the puppet or she may always give a handful, but the number she gives is unrelated to the numeral requested. A child at this level can be called a “pre-numeral-knower,” for she has not yet assigned an exact meaning to any of the numerals in her memorized numeral list.

At the next level (which most English-speaking children reach by age 2-1/2 to 3 years) the child knows only that “one” means one. On the Give-N task, she gives one object when asked for “one,” and she gives two or more objects when asked for any other numeral. This is the “one”-knower level.
The discursive functioning of knowledge claims in research studies

Some months later, the child becomes a "two"-knower, for she learns that "two" means two. At that point, she gives one object when asked for “one,” and two objects when asked for “two,” but she does not distinguish among the numerals “three,” “four,” “five,” etc. For any of those numerals, she simply grabs some objects and hands them over. This level is followed by a "three"-knower level, and some studies also report a "four"-knower level. Collectively, children at these levels have been termed "subset-knowers" (Le Corre and Carey, 2007 and Le Corre et al., 2006) because although they have often memorized the numeral list up to "ten" or higher, they know the exact meanings for only a subset of those numerals.

After the child has spent some time (often more than a year) as a subset-knower, her performance undergoes a dramatic change. Suddenly, she is able to generate the right cardinality for numerals “five” and above. But whereas she progressed through the subset-knower levels gradually (learning “one,” then “two,” then “three,”...) she seems to acquire the meanings of the higher numerals (“five” through however high she can count) all at once. We call children at this level cardinal-principle-knowers (sometimes abbreviated CP-knowers).

Within-child consistency on a wide variety of tasks suggests that cardinal-principle-knowers differ qualitatively from subset-knowers. Most conspicuously, subset-knowers do not use counting to solve the Give-N task (even if they are explicitly told to count), whereas cardinal-principle-knowers do use counting – an observation that led Wynn, 1990 and Wynn, 1992 to call subset-knowers “grabbers,” and cardinal-principle-knowers “counters.” But the differences do not end there. For example, a "two"-knower is, by definition, unable to give three objects when asked for “three.” But a “two”-knower is also

(a)

unable to fix a set when told, for example, “Can you count and make sure you gave the puppet three toys?... But the puppet wanted three – Can you fix it so there are three?” (Le Corre et al., 2006);

(b)

unsure whether a puppet who has counted out seven items has produced a set of “seven” (Le Corre et al., 2006);

(c) 5; 9-29

unable to point to the card with “three” apples, given a choice between a card with three and a card with four (Wynn, 1992); and

(d)

unable to produce the numeral “three” to label a picture of three items (Le Corre et al., 2006).

Cardinal-principle-knowers succeed across the board on these tasks. Such qualitative differences in the counting behavior of subset-knowers and cardinal-principle-knowers suggest that what ultimately separates the groups is not just...
The discursive functioning of knowledge claims in research studies

The size of the sets they can generate. Rather, it is that cardinal-principle-knowers understand how counting works, whereas subset-knowers do not.

Because these two groups are separated by their knowledge of the cardinal principle, they offer us a way of finding out whether the How-Many task underestimates, overestimates, or accurately taps cardinal-principle knowledge. More importantly, they give us a way to explore the nature of cardinal principle knowledge itself.

1.2. Unpacking the cardinal principle

The cardinal principle is often informally described as stating that the last numeral used in counting tells how many things are in the whole set. If we interpret this literally, then the cardinal principle is a procedural rule about counting and answering the question ‘how many.’ If so, then cardinal-principle-knowers should answer the ‘how many’ question correctly (i.e., they should repeat the last word of a count) whereas subset-knowers should not. In other words, the How-Many task should accurately tap cardinal-principle knowledge. The first question of the present study then, is: Is the cardinal principle a procedural rule about counting and saying ‘how many’?

Alternatively, the cardinal principle can be viewed as something more profound – a principle stating that a numeral’s cardinal meaning is determined by its ordinal position in the list. This means, for example, that the fifth numeral in any count list – spoken or written, in any language – must mean five. And the third numeral must mean three, and the ninety-eighth numeral must mean 98, and so on.

If so, then knowing the cardinal principle means having some implicit knowledge of the successor function – some understanding that the cardinality for each numeral is generated by adding one to the cardinality for the previous numeral. The second question of the present study then, is: Is the cardinal principle a conceptual rule that is related to knowledge of the successor function?

If children know how the numeral list instantiates the successor function, they should understand two things: (1) The direction of numerical change: In the numeral list, the word that denotes cardinality \(N + 1\) will come after the word denoting cardinality \(N\). (2) The unit of numerical change: The word for cardinality \(N + 1\) must be the very next word in the numeral list, after the word for cardinality \(N\).

1.3. The present study

In order to answer the first question (i.e., Is the cardinal principle a procedural rule about counting and saying ‘how many’?) We devised a How-Many task that avoids the pragmatic oddness of asking how many items are in a set the child just counted. In our task, the experimenter counted a set the child could not see, and then asked the child how many items there were. This task allowed us to assess when children learn a procedural ‘how-many’ rule (i.e., a rule saying that the answer to the question ‘how many’ is the last word of a count) and whether mastery of this rule corresponds to understanding of the cardinal principle (as measured by the Give-N task).
The discursive functioning of knowledge claims in research studies

To answer the second question (i.e., *Is the cardinal principle a conceptual rule that is related to knowledge of the successor function?*), we devised two tasks (the Direction task and the Unit task) to tap children’s understanding of how the direction and unit of numerical change are represented by moving forward or backward along the numeral list. If knowledge of the cardinal principle is closely related to knowledge of the successor function, then cardinal-principle-knowers should succeed at these two tasks and subset-knowers should fail. These tasks are especially suitable because they involve addition and subtraction from sets, which according to Gelman and colleagues is the best way to reveal children’s conceptual competence with respect to number representation (Cordes and Gelman, 2005 and Zur and Gelman, 2004).

The strategy of the present study thus involved testing each child on six different tasks. First, the Give-N task was used to sort children into knower-level groups. Next, two tests of counting fluency (the Sequence and Correspondence tasks) were included to provide a baseline measure of the child’s mastery of the numeral sequence and standard counting procedure. Then, our How-Many task was used to probe the child’s understanding that the last word in a count sequence is the correct answer to a subsequent ‘how many’ question. Finally, two new tasks (the Direction and Unit tasks) tested whether children knew that (a) adding an element to a set requires going forward in the numeral list to represent the cardinality of the resulting set, whereas subtracting requires going backward (the Direction task) and (b) if one item is added, the resulting cardinality is named by next numeral in the list, whereas if two items are added, the resulting cardinality is named by the numeral after that (the Unit task).
APPENDIX 5: SIMILARITIES BETWEEN PROCEDURAL AND CONCEPTUAL KNOWLEDGE CLAIMS

Given the sometimes unclear difference between knowledge claims and justifications, it is perhaps not surprising to find that the boundary between different types of knowledge claims was also blurry. Specifically, the distinction between procedural and conceptual knowledge—a distinction which was prominent in several of the analyzed texts, and raised in all of them—did not correspond, on a discursive level, with knowledge claims that appeared to function in categorically different ways. In one example of this, Nikoloska (2009) makes an explicit distinction between so-called procedural knowledge and conceptual knowledge. The claim is that younger children have procedural knowledge of counting (or in some cases, it is merely claimed that they “can count (correctly)”, but lack conceptual knowledge. While treated as two qualitatively different forms of knowledge, both procedural and conceptual knowledge are shown to function--within the language game of knowledge claims--in roughly the same way as knowledge claims. This is illustrated with the following quotes from the Nikoloska (2009) text. The first quote mentions the distinction between procedural and conceptual knowledge.

Although most researchers (Wynn, 1990; Le Corre, Van de Walle, Brannon & Carey, 2006) seem to agree that in the verbal counting domain the procedural knowledge (skill) develops before the conceptual knowledge (the underlying principles that govern the counting), the issue is debated (Siegler & Rittle-Johnson, 1998). [2; 18-20]

This distinction is reflected in the empirical study reported in the text, which involves a measure of conceptual knowledge (the Give-N task) and procedural knowledge (a basic measure of counting ability). The latter is described in the quote below:
The discursive functioning of knowledge claims in research studies

Upon arrival the child was given 10 yellow blocks arranged in a straight line approximately 1 cm apart and was asked to count them. The purpose of this task was to see whether the child could count to 10 and whether they used the standard counting sequence or not. If they did not manage to count to 10 they were given the counting task again at the end of the session to see whether they knew the counting sequence to 10 but failed to demonstrate that knowledge. [7; 40-44]

The above quote describes an attempt to measure what researchers refer to as procedural knowledge. Despite the centrality of the conceptual vs. procedural knowledge distinction in the literature, the quote shows that the way that knowledge claims for procedural knowledge are justified (implied in the above quote) is essentially similar to the way claims about conceptual knowledge are justified. Namely, a behavioral performance is used to justify the assertion of a more general knowledge claim (the latter is described in the quote in several ways, first as count to ten and use the standard counting procedure, later as count to 10, and finally as that knowledge.
The discursive functioning of knowledge claims in research studies

APPENDIX 6: CODING MANUAL

The general approach taken in this research involved approaching each selected text with a familiarity with the general discursive context in which the text is produced—which was possible given the author’s familiarity with the body of research involved. This refers to a sufficient level of intersubjectivity (or shared understanding) with the discursive context into which each text was collaboratively produced to make the logic of the text apparent, at least in most places (an exception might be descriptions of highly technical statistical procedures). Such intersubjectivity is lacking when one reads a text in an unintelligible foreign language, or reads a highly technical paper outside of one’s field of expertise. This intersubjectivity was necessary to the analytic process carried out in the current research. Without it, it would have been impossible to identify exemplars of the initial analytic categories (knowledge claims, justifications, explanations) and by extension, to refine these categories and develop the general model of knowledge claim functioning. Exemplars of each of the categories were identified according to the criteria listed below (Note: the following criteria are the final criteria arrived at at the outcome of the current research. They do not, for example, describe the criteria used in the initial analysis. Presenting anything besides the final criteria would be impossible, since only the final criteria are systematic.

Knowledge claims include:

- Claims that a someone knows *that* *x*
- Claims that someone knows *how* to *x*
- Claims that someone *did/will do/can do* *X*
  - These claims must be things that a person does intentionally and non-accidentally (i.e., not descriptions of things that a person happened to do by chance, or did once, but could not do again, or actions that are implied to be
The discursive functioning of knowledge claims in research studies

possibly unintentional as a result of the use of criteria for repetition (e.g., children passed the task if they got at least 9/10 answers correct.

- Any of the above types of statements that use alternatives to the verb know such as understand, grasp, realize, comprehend, infer, has a concept of etc.
- Groupings of knowledge claims (see section on grouping below)
- Statements that don’t look like other knowledge claims as a result of phrasing and possibly involving objectification/reification or other forms of figurative language, but which otherwise function as such (i.e., are justified, contested, negotiated). Examples:
  - The child’s concept of number is abstract
    - This statement may be used as a knowledge claim that means children are able to act in accordance with specific numerical principles across a wide variety of situations. A version of the original statement with a grouping would also be considered a knowledge claim (e.g., the abstraction of a child’s concept of number).
  - Children’s invariance schemes contain rules for reversing operations
    - This is two knowledge claims. The first is essentially the claim that children know that addition and subtraction (but not displacement) change the numerosity of a set. The second is the claim that they also know which operation is needed to reverse the effects of addition/subtraction to return a set to its original numerosity.
- Knowledge claims embedded in researcher’s questions to children
  - e.g., “Where do you think the winner is?” would count, but “Is that the winner” would not. However, a report that the child says “That’s the winner” would count.

Knowledge claims are not:

- Sections of statements that modify the application of a given knowledge claim (e.g., higher level knowledge claims). For example, consider the claim: Children
The discursive functioning of knowledge claims in research studies

Knowing number words are precise before they become CP knowers. In this example, knowing number words are precise and cp-know[ing] would be knowledge claims. The claim that one form of knowledge occurs “before” the other would not be included, since this is not a knowledge claim per se, but rather the result of a statement constructed by integrating across multiple knowledge claims.

○ References to what the experimenter or researcher knows/does, unless given to address some issue relevant to the study of the child’s knowledge are not counted (despite being knowledge claims).

○ Descriptions of what the children do related to describing the sample (e.g., “all children attended the preschool”)

○ Descriptions of passive things the child “does”, such as “seeing the display”

○ Descriptions of passive states such as “readiness”
  ■ e.g., “The child was ready”

Groupings of knowledge claims

Groupings refer to the conglomeration of related varieties of either knowledge claims (or justifications). Groupings of knowledge claims involve the grouped positive and negative assertions of the claim (note that the expanded category of knowledge claims includes both statements literally about what someone knows, as well as statements about what they did, e.g., on a task). Examples of groupings:

● Knowledge of the cardinal principle (implying knowing/not knowing the cardinal principle).

● Performance on the Give-N task (implying passing/failing the Give-N task)
The discursive functioning of knowledge claims in research studies

- *The Give-N task measures the cardinal principle* (this statement would be interpreted as a grouped justification (the Give-N task) and a grouped knowledge claim (the cardinal principle)).

**Justifications are:**

- Any reason given in support (or entertained as possible support) for the assertion/denial of a knowledge claim
- Groupings of justifications
- A citation may be a part of a justification, although it is taken as a reference to a more detailed statement(s) functioning as a justification in another text (the exception to this is in the Addressivity analysis (Appendix 2), where the issue of whether or not something is made explicit, or merely cited is relevant). Citations are only included as justifications when they are explicitly framed as such. Citations that are given to indicate who made a particular claim do not count.

**Justifications are not:**

- Explanations, i.e., statements that mediate the relationship between a knowledge claims and justifications do not count as justifications.
- Descriptions of individual behavioral events that, for various reasons, are treated as though they may not be capacities are not counted as knowledge claims. For example, if a knowledge claim is asserted contingent on a child’s passing a certain task, and passing the task is defined as some number of consecutive correct answers, then descriptions of individual answers are not considered to be part of the justification, unless they are clearly used to determine the assertion/contestation of a given knowledge claim.
The discursive functioning of knowledge claims in research studies

- The description of certain types of inability do not function as justifications. For example consider the example of the claim that *children whose knowledge of counting is limited to recitation of the counting procedure would have no obvious basis for using counting to compare two sets*. This case would contain a knowledge claim (first half), but the description of what someone with this knowledge could *not* do (second half) would not constitute a justification.

**What Counts as an Explanation?**

Any statement that explains why a particular justification is or would be grounds for the assertion/denial of a knowledge claim, or any statement that explains why a particular knowledge claim is grounds for the expectation of a particular justification.

There were four unique types of explanations:

**Type 1a Explanations:** Any statement that addresses the pairing (or lack thereof) between a knowledge claim and justification in relation to the presence of unexpected concurrent validity or the absence of expected concurrent validity. There are a variety of types of 1a explanations:

- Lack of concurrent validity explained in terms of performance factors: *Children who pass the Give-N task don’t necessarily demonstrate knowledge of cardinality on other tasks because of excessive performance demands.* (In this example, the other tasks which lack concurrent validity with the Give-N task are explained to involve excessive performance demands.

- Lack of concurrent validity explained as a result of successful performances being due to simple procedural knowledge, rather than conceptual knowledge: *Children who pass the How-Many task still fail other measures of cardinality knowledge, such as the Give-N task, which suggests that they pass the How-Many task by using a simple procedural rule, rather than a true understanding of cardinality.*
The discursive functioning of knowledge claims in research studies

- In many Type 1a explanations, the lack of concurrent validity may be implicit, i.e., logically entailed, rather than explicitly mentioned.

- For instance, in descriptions of methodological details that are given with the explicit purpose of ruling out other (implied) knowledge claim-justification pairings would be considered Type 1a explanations. These explanations need not mention non-concurrent performance on other tasks; this is implied by the mention of things like performance factors. Example:
  - Children’s failure on the task was not due to memory error, since they passed a memory check afterwards. (although a lack of concurrent validity is not mentioned, it is implied by the mention of the memory check. The memory check reflects an anticipated objection to the validity of the mentioned task involving an otherwise similar task that lacks the memory demands, and on which performance might be expected to be better.

- Presence of concurrent validity between successful/unsuccesful performance on measures of two different knowledge claims used to argue that one measure is a measure of both knowledge claims.
  - Example: Children who pass the Give-N task also pass many other counting tasks that children who fail the Give-N task fail. Therefore, children who pass the Give-N task don’t just understand the cardinal principle, they understand how counting works more generally.

**Type 1b Explanations:** Any statement(s) that claim that a particular knowledge claim can be the only implication of a particular justification, because no other conclusion is possible. For example

- There is no other explanation for why children would change their answer except that they understood that the addition of an item changed the numerosity of the set.
The discursive functioning of knowledge claims in research studies

Type 2a Explanations: Any statement(s) that negotiate the pairing or lack thereof between a knowledge claim and justification by identifying the text with a specific discursive community within which the claim would be normative. For example:

- *What does it mean to know numbers? Well, parents talking [in informal conversational settings] could claim their children understand numbers if they can recite the counting list.*

- Although these were not included in the analysis, any indicators within the text, or in the context in which it is accessed by a reader, which align it with a specific discourse could be considered to be, or at least function as Type 2a explanations.

Type 2b Explanations: Explanations that involve explicit description of why a particular justification and knowledge claim are or are not paired with each other. Type 2b explanations encompass most cases of Types 1a and 1b explanations. The only exceptions are Type 1a explanations premised on the finding of unexpected concurrent validity between justifications of different knowledge claims, which is used to argue that one of the justifications is a measure of both knowledge claims. However, Type 2b explanations don’t necessarily have the specific qualities of either Types 1a or 1b (i.e., they don’t necessarily reflect an explicit or implied lack of concurrent validity, and they don’t necessarily claim that there can be no other conclusion, as Type 1b explanations do). For example:
APPENDIX 7: OBJECTIFICATION

Cases of Conclusions Reached about Objectified Forms of Knowledge

Researchers used the discursive technique of objectification to treat the knowledge described in knowledge claims as if it were an object, rather than merely a description of a capacity. As defined by Sfard (2008), objectification involves the reification of a discourse-dependent object (treating it as if it were a real entity in the world), and the alienation of that object from the discursive contexts in which it is constructed. In the case of knowledge claims (specifically conceptual knowledge of number and counting), objectification can be seen in the treatment of the knowledge described in knowledge claims as if it were an actual entity whose existence and specifications can be studied empirically (albeit indirectly). While conclusions made about objectified forms of knowledge are still fundamentally descriptions of capacities, the discursive possibilities provided by objectification allow for them to be reached and characterized in somewhat novel ways. So, rather than conclusions being of the form s/he knows X, they can take a variety of different forms, as illustrated by the following examples.

Conclusions Drawn About Objectified Forms of Knowledge

Example 1

Objectification is evident in investigations report findings about not just what children know, but also about the nature of the knowledge itself. Gelman's (1972) research provides one example of this:

Because the operations of displacement and rearrangement produce changes in the irrelevant properties of a set (e.g., length, area, configuration), a demonstration of the use of invariance rules provides evidence with which to assess the conception of number. If the judgment of number for sets of X (when X is a cardinal number) is not
The discursive functioning of knowledge claims in research studies

altered by these changes, we may conclude that the person's concept of number does not depend on any of these properties and that the sets of X that include variations in these properties are treated as belonging to the same cardinal number class. [3; 6-13]

In the above quote, the child’s knowledge of number is objectified as a concept they possess, and consequently, pertinent justifications (i.e., “the child’s judgment of number…[being] unaltered by these changes”) are not directly used as the basis of claims about what the child knows, but are instead treated as if they provided information about a little-known but real object: the child’s concept of number. In unobjectified form, this conclusion might be phrased as the person knows that number is not altered by changes in length, area or configuration. The technique of articulating findings as if they represented additional information learned about knowledge-as-object) is also seen in the Sarnecka and Wright (2013) text, whose conclusion clearly objectifies “the concept of five/six”. This is evident in the following short quote from the abstract of that article:

The present study investigates the link between cardinality and equinumerosity for these numbers, finding that children either understand both cardinality and equinumerosity, or they understand neither. This suggests that cardinality and equinumerosity (along with succession), are interrelated facets of the concepts five and six, the acquisition of which is an important conceptual achievement of early childhood. [1; 22-25]

Over the course of the Sarnecka and Carey (2008) article as a whole, the conclusion about “interrelated facets of the concept” is constructed in the following way. First, researchers draw on standard routines and practices of knowledge claim discourse, justifying two claims (specifically the claims that children understand cardinality and [that they understand] numerosity for the numbers five and six) in terms of observed task behaviors. Then, since the
The discursive functioning of knowledge claims in research studies

claims were found to be concurrent (children either knew both, or neither), they are claimed to be related aspects of the concept of five/six.

This assertion is accomplished by adapting a routine from knowledge claim discourse (the equating of one claim with another) onto the basic conceptual metaphor (Lakoff & Johnson, 1980; Lakoff and Johnson, 1999) of an object (objects are things that can have different aspects). Without this figurative language, the statement might have been phrased in the following way:

Children who understand (i.e., have a concept of) the number five also understand the cardinal meaning and principle of numerosity for the number five.

Example 2

In yet another example, an objectified notion of knowledge is taken even further than has previously been illustrated. Proceeding from the assumption that children who pass the Give-N task can be claimed to understand the cardinal principle, Sarnecka and Carey (2008) attempt to extend these claims by asking about the specific nature of the known cardinal principle. This constitutes a notable use of the knowledge claim language game, embodying many features of the model, albeit in an idiosyncratic way. As such, it is worth quoting at length.

The cardinal principle is often informally described as stating that the last numeral used in counting tells how many things are in the whole set. If we interpret this literally, then the cardinal principle is a procedural rule about counting and answering the question ‘how many.’ If so, then cardinal-principle-knowers should answer the ‘how many’ question correctly (i.e., they should repeat the last word of a count) whereas subset-knowers should not. In other words, the How-Many task should accurately tap cardinal-principle knowledge. The first question of the present study then, is: Is the cardinal principle a procedural rule about counting and saying ‘how many’?
The discursive functioning of knowledge claims in research studies

Alternatively, the cardinal principle can be viewed as something more profound – a principle stating that *a numeral’s cardinal meaning is determined by its ordinal position in the list*. This means, for example, that the fifth numeral in any count list – spoken or written, in any language – must mean five. And the third numeral must mean three, and the ninety-eighth numeral must mean 98, and so on.

If so, then knowing the cardinal principle means having some implicit knowledge of the successor function – some understanding that the cardinality for each numeral is generated by adding one to the cardinality for the previous numeral. The second question of the present study then, is: *Is the cardinal principle a conceptual rule that is related to knowledge of the successor function?* [6; 4-16]

The above question seems highly unlike other discourse about children’s knowledge, which pertains to what children (do/don’t/may) know. In contrast, the above question starts with a form of knowledge—*the cardinal principle*—and asks what kind of knowledge it is. Since the model of knowledge claim discourse developed here suggests that knowledge is merely a discourse construct, how is it possible to answer such a question—i.e., to investigate “the knowledge itself?” As the following explanation will show, despite the apparent novelty of this question, it and its answer can be fully explained in terms of the model developed here.

The unique character of Sarnecka and Carey’s question is a result of the way that the researchers equate knowledge claims, their justifications, and the children who perform the behaviors described in these. This occurs in several steps. First, the authors assess whether successful performance on the Give-N task was concurrent with success on tasks that measure (a) knowledge of a procedural rule and (b) knowledge of the successor function. Based on these results, the authors could have made conclusions such as the following:

*While many children (including many who fail the Give-N task) pass a task measuring knowledge of a procedural rule for counting and saying how many, only those children...*
The discursive functioning of knowledge claims in research studies

who pass the Give-N task also pass tasks measuring knowledge of the successor function, and vice versa. Consequently, these may be related.\textsuperscript{43}

However, instead of phrasing the conclusion in this way, the authors instead equate children who performed successfully on the Give-N task with that performance itself, and further equate that performance with the knowledge claim it justifies (knowledge of the cardinal principle). Having done this, they are forced to state the conclusion as if it were about the knowledge, since the alternative would not be grammatically possible (i.e., one could not say only knowledge of the cardinal principle also understands the successor function.

The results reported by Sarnecka and Carey are not as clear cut as those described in the above example conclusion. In short, they found that success on the Give-N task was not concurrent with the measure of procedural knowledge (which was achieved by many children who were not yet CP-knowers), nor was it concurrent with the results of one (but not the other) measure of the successor function. Consequently, they are unable to say, unequivocally, that the cardinal principle is either a procedural rule or a conceptual rule. However, their methodology and arguments throughout the text suggest that these are precisely the conclusions they had intended to make.

Sarnecka and Carey’s (2008) findings showing a lack of concurrent validity between CP-knowing and the other measures are treated as surprising under the assumption that the rapidly improving performance on the Give-N task that’s indicative of becoming a CP-knower must be the reflection of some underlying knowledge that is separate from the performance itself. In other words, it is assumed that an increase in performance can only occur on the basis of some additional underlying knowledge. This assumption reflects the objectification of knowledge, insofar as this line of reasoning treats the knowledge as separate from the performances that it generates/causes.

\textsuperscript{43} This was not the actual conclusion of Sarnecka and Carey’s (2008) study, which produced mixed results. What is presented in the above example is a simplified outcome which makes the methodological and interpretive practices of the authors more clear.
The discursive functioning of knowledge claims in research studies

Of course, there is necessarily something different about a child who shows the behavior of a CP-knower versus a subset knower on the Give-N task. It makes very little sense to say that two children are identical as organisms in every sense except that they will perform very differently on one particular task. Such differences must have a cause that is separate from the observed effect. Yet, it does not follow that this difference is something that can be adequately characterized at the general level of a knowledge claim. To assume otherwise is to conflate the reasons and causes of behavior.
The discursive functioning of knowledge claims in research studies

BIBLIOGRAPHY


The discursive functioning of knowledge claims in research studies


The discursive functioning of knowledge claims in research studies


The discursive functioning of knowledge claims in research studies


The discursive functioning of knowledge claims in research studies


The discursive functioning of knowledge claims in research studies


The discursive functioning of knowledge claims in research studies


